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NAS WHITING FIELD  
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REMEDIAL INVESTIGATION WORK PLAN FOR SITE 40 NAS WHITING FIELD FL  
10/22/2007  
TETRA TECH NUS

# **C**omprehensive **L**ong-term **E**nvironmental **A**ction **N**avy

CONTRACT NUMBER N62467-94-D-0888



Rev. 1  
10/22/07

## **Remedial Investigation Work Plan for Base-Wide Groundwater Assessment Activities at Site 40 and Well Abandonment**

**Naval Air Station Whiting Field  
Milton, Florida**

**Contract Task Order 0064**

**October 2007**



**Southern Division**

**Naval Facilities Engineering Command**

**2155 Eagle Drive**

**North Charleston, South Carolina 29406**

**REMEDIAL INVESTIGATION WORK PLAN  
FOR  
BASE-WIDE GROUNDWATER ASSESSMENT  
ACTIVITIES AT SITE 40 AND  
WELL ABANDONMENT**

**NAVAL AIR STATION WHITING FIELD  
MILTON, FLORIDA**

**COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:  
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**CONTRACT NO. N62467-04-D-0055  
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**OCTOBER 2007**

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## ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
bls	below land surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-DCE	cis-Dichloroethene
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
CTO	Contract Task Order
DCE	Dichloroethene
DNA	Deoxyribonucleic acid
EDB	1,2-Dibromoethane
EISOPQAM	Environmental Investigation Standard Operating Procedures and Quality Assurance Manual
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FOL	Field Operations Leader
FS	Feasibility Study
ft	foot/feet
GCTL	Groundwater Cleanup Target Level
GIR	General Information Report
HASP	Health and Safety Plan
IDW	Investigation Derived Waste
IR	Installation Restoration
LNAPL	Light Non-aqueous Phase Liquid
MS	Matrix Spike
MSD	Matrix Spike Duplicate
msl	mean sea level
NAS	Naval Air Station
NAVFAC SE	Naval Facilities Engineering Command Southeast
NEESA	Naval Energy and Environmental Support Activity
NELAP	National Environmental Laboratory Accreditation Program
PCE	tetrachloroethene
QA	Quality Assurance
QC	Quality Control

RCRA Resource Conservation and Recovery Act

**ACRONYMS (Continued)**

RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
TAL	Target Analyte List
TCE	Trichloroethylene
TCL	Target Compound List
TOM	Task Order Manager
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VC	Vinyl Chloride
VOC	Volatile Organic Compound
WP	Work Plan

## **1.0 INTRODUCTION**

Tetra Tech NUS, Inc., (TtNUS), under contract to the Department of the U.S. Navy, Naval Facilities Engineering Command Southeast (NAVFAC SE) is submitting this Work Plan (WP) to describe a groundwater sampling plan designed to provide additional recent groundwater chemical data. This additional data will be used to support conclusions presented in the Site 40 Base Wide Groundwater Remedial Investigation (RI). This WP will also describe monitoring well abandonment procedures to be applied to monitoring wells listed in the body of this WP. This WP was prepared under the Comprehensive Long-term Environmental Action Navy (CLEAN) IV Contract Number N62467-04-D-0055, Contract Task Order (CTO) 0064.

### **1.1 PURPOSE OF THE WORK PLAN**

This WP provides guidance in fulfilling two objectives. The primary objective, groundwater sampling, will verify the presence and measure concentrations of known contaminants in groundwater located beneath the north and south industrial areas and in respective downgradient areas. The secondary objective is to properly abandon groundwater monitoring wells installed during RI and underground storage tank (UST) investigations at sites where investigations are complete and groundwater samples from these wells have indicated groundwater is not contaminated. These wells have been selected for abandonment to remove the potential for unauthorized direct access to groundwater as described by the North West Florida Water Management District.

The work will include collection and analysis of groundwater samples from known contaminated areas and adjacent areas. No background samples will be collected at established background well locations. Groundwater samples will be submitted to a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) contract laboratory program (CLP) approved and National Environmental Laboratory Accreditation Program (NELAP)-certified laboratory for analysis.

This WP specifies the sampling protocol and procedures for data collection and sample analysis, sample locations, sample designations, sample handling, sample equipment, and handling of investigation derived waste (IDW). This plan was prepared in accordance with the TtNUS Corporate Quality Assurance Program Manual, dated 1 January 2001, and the TtNUS Florida Regional Quality Assurance Program Manual, dated 9 October 2002, and the United States Environmental Protection Agency (USEPA) Region 4, Environmental Investigations Standard Operations and Procedures and Quality Assurance Manual (EISOPQAM), dated November 2001.

## **1.2 SITE DESCRIPTION AND HISTORY**

Naval Air Station (NAS) Whiting Field is located in Santa Rosa County, in Florida's northwest coastal area, approximately 5.5 miles north of Milton and 25 miles northeast of Pensacola (Figure 1-1). Mobile, Alabama is approximately 79 miles west of the air station, and Tallahassee, the capitol of Florida, is 174 miles to the east. NAS Whiting Field is approximately 3,842 acres in size, and consists of two airfields (North and South) separated by a central area. The North Field is used for fixed-wing aircraft training and the South Field is used for helicopter training. NAS Whiting Field, home of Training Air Wing Five, was constructed in the early 1940s. It was commissioned as the Naval Auxiliary Air Station Whiting Field in July 1943 and has served as a naval aviation training facility since then. The facility's mission has been to train student naval aviators in the use of basic instruments; formation and tactic phases of fixed-wing and propeller-driven aircraft; and in the basic and advanced portions of helicopter training.

NAS Whiting Field is located in the Western Highlands subdivision of the Coastal Plain Physiographic Province. This province is characterized by a well-drained southwestward sloping plateau. A drop in elevation of approximately 100 feet (ft) across NAS Whiting Field to Clear Creek reflects this physiography. NAS Whiting Field is drained by an extensive storm sewer drainage system constructed in the mid-1940s. Extensive slope contouring and the construction of paved drainage ditches channel water from NAS Whiting Field to Clear Creek and Big Coldwater Creek [RI/Feasibility Study (FS) General Information Report (GIR), ABB-Environmental Services (ABB-ES) 1997].

## **1.3 ANTICIPATED SUBSURFACE CHARACTERISTICS**

A general discussion of the geologic interpretation from the land surface to approximately 50 ft below mean sea level (msl) or 150 ft below land surface (bls) is presented in subsection 1.4.5 of the GIR (ABB-ES, 1997). Further detail for this interval is presented in Chapter Three of the RI/FS Technical Memorandum No. 2 Geologic Assessment (ABB-ES, 1995). Geologic observations from the installation of 28 monitoring wells penetrating the same interval during the year 2000 investigation correlates with and supports the conclusions presented in these two documents.

In brief, the lithology of this shallow zone consists of lightly colored (white to tan to orange to red-orange), poorly graded sands (fine- to medium-grained) with interstitial silts and clays. These sand and clay beds are not typically extensive and are interbedded with silt and clay layers with similar color schemes. These sediments are associated with a distinctive limonite-cemented sandstone found on and near the surface, at depth in several borings, and immediately above the Pensacola Clay. The oxidized color scheme continues down to the top of the Pensacola Clay. The lithology and stratification of the material

encountered at NAS Whiting Field are consistent with the description of the Citronelle Formation (Marsh, 1966; Scott, 1992; ABB-ES, 1995).

The sedimentary patterns described above are typically associated with a fluvial or riverine environment of deposition. As such, sand or clay beds may be continuous over several or tens of acres. Due to the nature of the depositional processes; however, lack of correlation over even short distances indicates these beds were likely frequently truncated by post deposition erosion during the ongoing fluvial processes. Clay layers within the Citronelle Formation have been extensive enough to confidently map over small areas, but frequently are discontinuous, vertically inconsistent, and cannot be confidently traced between borings over longer distances. Therefore, they are not believed to be significant or massive subsurface features (ABB-ES, 1995).

The Citronelle Formation is described by Marsh (Marsh, 1966) as lying unconformably over the lower member of the Pensacola Clay. At NAS Whiting Field, a massive layer of dark to light gray clay typically silty with very fine to coarse micaceous quartz sand is found across the facility at a depth of approximately 75 ft below msl. Associated carbonized wood and plant material (leaves and reeds) are present throughout the formation as well as intermittent layers with abundant mollusk shells. These characteristics are consistent with Marsh's (Marsh, 1966) description of the lower member of the Pensacola Clay.

The upper surface of this massive clay had been encountered during the well installation at Sites 15 and 16 in the mid 1990s; however, the amount of data generated was insufficient to conclusively determine the unit was laterally extensive and, therefore, not immediately useful. Prior to the installation of deeper monitoring wells during the year 2000 field event, only two wells (WHF-30-MW-3D South Field and WHF-32-MW-3D North Field) were intentionally installed to the top of the massive clay (ABB-ES, 1998).

The installation of 15 deep borings or monitoring wells installed in year 2000 provided data sufficient to allow definition of the upper surface of the massive clay. The massive clay is identified as the top of the lower clay member of the Pensacola Clay and is typically found from approximately 50 to 75 ft below msl at the facility. The Pensacola Clay is considered a confining unit with very low permeability (Hayes and Barr, 1983). This data was collected from borings advanced to just below the top and up to 225 ft into the Pensacola Clay. Depth to groundwater is estimated to vary from 6 ft bls near Clear Creek to 110 ft bls in the industrial area of NAS Whiting Field.

## **1.4 REGULATORY SETTING**

The Navy IR Program was designed to identify and abate or control contaminant migration resulting from past operations at naval installations, with the goal of expediting and improving environmental response actions while protecting human health and the environment. The IR program is conducted in accordance with Section 120 of the CERCLA (1980) as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and Executive Order 12580. CERCLA requires federal facilities to comply with the act, both procedurally and substantively. Due to the nature of the remedial activities proposed at Sites 4 and 7 (the four hangar areas, used oil/solvent tanks, and aircraft wash rack areas), the investigation will be conducted in general accordance with Chapter 62-777, Florida Administrative Code (F.A.C.) and in general accordance with guidance provided in the Storage Tank System Closure Assessment Requirements of Chapter 62-761, F.A.C. and CERCLA guidance.

## **1.5 REPORT ORGANIZATION**

This WP is organized into seven sections as follows:

- Section 1.0 – Presents the purpose, site location, description, history, and regulatory setting at NAS Whiting Field.
- Section 2.0 – Presents the technical approach to the sampling and analysis.
- Section 3.0 – Presents the procedures and methods for conducting the project-specific field investigation activities to be performed.
- Section 4.0 – Presents methods of data validation and Site Characterization Reporting.
- Section 5.0 – Presents project schedule
- References – Lists supporting references used in preparing this WP.
- Appendices – Provide relevant supporting data to material provided in text.

## 2.0 TECHNICAL APPROACH

### 2.1 OVERVIEW

The extent and characteristics of groundwater contamination at NAS Whiting Field are reasonably well known. The primary objective of this investigation is to determine current concentrations and areal extent of chemical constituents in groundwater. Samples will be collected from selected wells shown on Figures 2-1 and 2-2 and listed in Tables 2-1 and 2-2.

A review of groundwater monitoring well contaminant concentrations was conducted to aid in the selection of sample locations. Wells included in the sampling list are located either immediately upgradient, within known plume areas, or immediately cross- or downgradient. In addition, well depth intervals were reviewed to determine if trichloroethylene (TCE) analysis should be performed in intermediate wells if TCE had been found historically in an adjacent clustered shallow well. A selection of wells where benzene, toluene, ethylbenzene, and xylenes (BTEX) have been detected will be resampled. After the initial list based on organics was developed, the list was reviewed to reduce the number of wells thought to provide similar or redundant results. All well samples will be analyzed for target analyte list (TAL) metals. Finally, groundwater sample locations were selected for collection of microorganisms where BTEX and TCE comprise a mixed plume. This information will be used to evaluate natural attenuation parameters and future remedial designs.

The last groundwater sampling event occurred in 2000. On May 20 and 21<sup>st</sup>, 2007, groundwater levels were measured in approximately 50 wells located in the north and south central industrial area of NAS Whiting Field. Analysis of this data indicates depth to water appears to have dropped approximately 4 ft. This drop may impact some wells which were designed and installed in the mid 1990s to straddle the groundwater table. These few wells may currently be either dry or contain just a few feet of groundwater at the bottom of the screened interval. Other wells may have insufficient water to sample without compromising the representativeness of the groundwater sample. Options to ameliorate these issues are limited. Wells that are dry cannot be replaced, but in a few cases there are nearby wells that may be sampled. Wells with limited amounts of water (less than 2 ft) will be sampled with a positive air displacement (bladder) pump with a drop tube and a micropurge drawdown electronic water level meter.

The secondary objective is the abandonment of approximately 100 groundwater monitoring wells no longer in use. Wells not used for compliance monitoring are required to be abandoned before the Florida department of Environmental Protection (FDEP) can issue a final closure report or letter. All abandoned wells (Table 2-3) shall be filled and sealed in accordance with Rule 62-532.500(4), F.A.C., or with the rules of the permitting authority.

## 2.2 GROUNDWATER SAMPLING

Approximately 81 monitoring wells, listed in Table 2-1 and 2-2, will be sampled to determine the current groundwater conditions of the north and south field industrial area plumes (Figures 2-1 and 2-2). Prior to collecting groundwater samples, depth to water levels and total well depths will be measured. Water table elevation data generated from depth-to-water measurements will be used to estimate groundwater flow direction. The wells will be purged using a peristaltic or submersible inline pump with appropriate tubing and foot valve. Purging and sampling will be conducted using a low-flow quiescent method.

As described in Section 2.1 the water table has dropped approximately 4 ft since 1998. This water table drop will reduce the water column present in the shallow wells. Monitoring wells will not be sampled if it is determined the well is not providing representative groundwater relative to field parameters. The field parameters pH, temperature, conductivity, dissolved oxygen, and turbidity will be measured and recorded on Groundwater Sampling Log Sheets. Purging completion will be determined in accordance with USEPA Region 4 EISOPQAM (USEPA, 2001) and the State of Florida FS 2212, Well Purging Techniques (FDEP, 2004). An example of a Groundwater Sampling Log Sheet is provided in Appendix A.

Groundwater samples collected from the monitoring wells will be shipped to fixed-base laboratories for analysis. The list of the analyses for each groundwater sample is provided in Tables 2-4 and 2-5. Each of the groundwater samples will be analyzed for BTEX, tetrachloroethene (PCE), TCE, 1,2-dichloroethene (cis-DCE), vinyl chloride (VC), and TAL metals. Additionally, up to 10 wells in various areas of the north or south field plumes will be sampled for microbiological activity. This information will be used to evaluate natural attenuation parameters and future remedial designs. Groundwater sample volume, preservative, bottle type, and holding times are provided on Table 2-6. Groundwater samples will be collected in accordance with USEPA Region 4 EISOPQAM (USEPA, 2001) and the State of Florida FS 2220, Groundwater Sampling Techniques (FDEP, 2004).

Laboratory analytical results will be compared with both with USEPA Region 4 EISOPQAM (USEPA, 2001) and the Groundwater Cleanup Target Levels (GCTLs) specified in Chapter 62-777, F.A.C Final Report, dated February 2005. Groundwater samples will be analyzed for BTEX and cis-DCE by USEPA Method SW-846 8260B and 1,2-Dibromoethane (EDB) by USEPA Method 504.1, and TAL metals as specified by USEPA Method SW 846 6010B or 6020 except mercury which will be analyzed by EPA method 7470A. Nitrate and nitrite will be sampled by USEPA method 353.2.

Microorganism deoxyribonucleic acid (DNA) analysis will be performed on groundwater samples to determine if the Dehalococcoides spp is present in areas of TCE contamination. Bacteria capable of breaking down toluene and xylene will be sampled for in areas of BTEX contamination. Results of this information will be used to better define the groundwater environment for the selection of a remedial option that is protective of human health and environment. Microbial groundwater sample locations are shown in Tables 2-1 and 2-2.

Field activities, groundwater sampling, handling IDW etc. will be conducted in general accordance with the Site Specific Health and Safety Plan (HASP), USEPA Region IV CERCLA Guidance (USEPA, 2001) and FDEP Standard Operating Procedures (SOPs) for Field Activities (2004). In the event the USEPA Region IV CERCLA Guidance (USEPA, 2001) SOPs do not apply to a specific task, TtNUS will defer to the FDEP Standard Operating Procedures (SOPs) for Field Activities (2004) and subsequently to TtNUS Corporate SOPs (TtNUS, 2004). If Light Non-Aqueous Phase Liquid (LNAPL) is detected in purge water initially being pumped from a monitoring well at any given location, its presence will be noted, but groundwater samples will not be collected for laboratory analysis.

### **2.3 WELL ABANDONMENT**

Approximately 100 monitoring wells, listed in Table 2-3, will be abandoned. Wells not used for compliance monitoring are required to be abandoned before FDEP can issue a final closure report or letter. Wells selected for abandonment are groundwater monitoring wells installed during IR and UST investigations where investigations are complete and groundwater samples from these wells have indicated groundwater is not contaminated. These wells have been selected for abandonment to remove the potential for unauthorized direct access to groundwater as described by the North West Florida Water Management District. All wells shall be abandoned in accordance with Rule 62-532.500(4), F.A.C., or with the rules of the permitting authority. This direction requires abandonment by pressure grouting. Pressure grouting will be accomplished using a tremie pipe inserted to the bottom of the screened interval. Grout will be pumped under pressure to the bottom of the well and flow up the riser until it flows from the top of the casing under the supervision of a certified driller.

Table 2-3 list all monitoring wells installed and NAS Whiting Field. The wells are listed by identification number and the recommendation to either abandon or retain the well for further investigation. A brief rationale is provided if the well is selected for abandonment or retention.

### **3.0 FIELD OPERATIONS**

This section describes the procedures for conducting the project-specific field investigation to be performed during groundwater sampling at NAS Whiting Field. Field activities to be performed include health and safety, record-keeping, equipment calibration and maintenance, groundwater sampling, equipment decontamination, quality assurance (QA)/quality control (QC) sampling, sample nomenclature, handling and custody, waste handling, site management and base support, and surveying. The individual activities are described below.

#### **3.1 HEALTH AND SAFETY**

A HASP is provided as a separate document: *HASP for Base-Wide Groundwater Assessment Activities at Site 40 and Monitoring Well Abandonment*, April 2007.

#### **3.2 RECORD KEEPING**

In addition to chain-of-custody records associated with sample collection, packaging, and shipping, certain standard forms will be completed for sample description and documentation. These shall include sample log sheets (for groundwater samples), daily activity records and log books. Examples of these forms are provided in Appendix A.

Each field operations leader (FOL) will maintain a bound/weatherproof field notebook. The FOL or designee shall record the information related to sampling or field activities in the field book or on sample forms as required by the State of Florida. This information will typically include information such as sampling time, weather conditions, unusual events (e.g., well tampering), field measurements, descriptions of photographs, etc.

The FOL shall maintain a site logbook. This book will contain a summary of the day's activities and will reference the field notebooks and specific forms when applicable.

#### **3.3 EQUIPMENT CALIBRATION AND MAINTENANCE**

Field instruments will be calibrated in accordance with manufacturer's specifications. Calibration will be documented on an Equipment Calibration Log as shown in Appendix A. During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined the damage could have an impact

on the instrument's performance, the instrument will be removed from service until defective parts are repaired or replaced.

### **3.4 MONITORING WELL SAMPLING**

All groundwater samples collected from monitoring wells to be collected will be in general accordance with the procedures specified in USEPA Region 4 EISOPQAM Guidance (USEPA, 2001) and the State of Florida FS 2200, Groundwater Sampling SOP (FDEP, 2004). If LNAPL is detected in purge water initially being pumped from a monitoring well at any given location, its presence will be noted, but groundwater samples will not be collected for laboratory analysis.

### **3.5 EQUIPMENT DECONTAMINATION**

The equipment used in field sampling will be decontaminated prior to sampling in general accordance with the procedures specified in USEPA Region 4 EISOPQAM Guidance (USEPA, 2001) and the State of Florida FS 1000, Cleaning/Decontamination Procedures (FDEP, 2004).

#### **3.5.1 Sampling Equipment**

Equipment such as inline pumps and associated tubing used for collecting samples will be decontaminated prior to beginning field sampling and between sample locations. Water level measurement probes and other sampling equipment will be decontaminated as necessary, utilizing the following methods:

- Potable water and Alconox or liquinox detergent wash
- Potable water rinse
- De-ionized, analyte-free water rinse
- Isopropanol rinse except on plastics
- De-ionized, analyte-free water rinse
- Air dry
- Aluminum foil or zip-lock wrap until used

Instruments such as inline probes measuring pH, conductivity, and temperature for measuring field parameters will be rinsed first with tap water, then with de-ionized, analyte-free water.

### 3.6 DATA QUALITY REQUIREMENTS

The analytical methods to be used were included with each analysis in Table 2-6. The analytical data packages will be provided as per USEPA Region 4 EISOPQAM (USEPA, 2001) and the Naval Energy and Environmental Support Activity (NEESA) Level E (USEPA Level III) provisions. Each sample delivery group (SDG) of the analytical data will receive a full validation.

In addition to periodic calibration of field equipment and appropriate documentation, QC samples will be collected or generated during environmental sampling activities. QC samples may include rinsate blanks, field duplicates, trip blanks, and Matrix Spike (MS)/Matrix Spike Duplicates (MSDs). Each type of field quality control sample is defined as follows:

Rinsate Blank - Rinsate blanks are obtained under representative field conditions by running analyte free water through sample collection equipment (bailer, split-spoon, core barrel etc.) after decontamination. Rinsate blanks will be used to assess the effectiveness of decontamination procedures. If necessary, rinsate blanks may be collected for each type of non-dedicated sampling equipment used.

Field Duplicate - Field duplicate(s) are samples collected independently at a sample location during a single act of sampling under representative field conditions. Field duplicate sample frequencies are provided in Table 3-1. When collected, the duplicates shall be analyzed for the same parameters in the laboratory as the original samples are with the exception of natural attenuation parameters.

Trip Blanks - Trip blank(s) will be prepared at the laboratory facility and will accompany the volatile organic aromatic vials to the sampling site and back to the laboratory. Trip blanks are not required by the FDEP unless 10 or more volatile samples are collected during a given sampling event.

MS/MSD – A MS is an environmental sample with a known amount of target analyte added. A MS is intended to provide information about the performance of target analytes in the subject matrix. A MSD is an exact replicate of the MS and is used to assess precision in the subject matrix relative to the MS. The additional sample aliquots required for analysis of MS/MSD will be determined by the laboratory and will be collected at a frequency of 1 per 20 samples per matrix. Table 3-1 provides the frequency of collection for field quality assurance/quality control samples.

### 3.7 SAMPLE NOMENCLATURE

Each grab sample collected by any method will be assigned a unique codified sample identification number. The unique nomenclature established for this sampling event is as follows:

1	2	3
Site Location and Site Number	Well Number	Sample depth interval identifier
<u>WHF-04</u>	<u>G026</u>	<u>01</u>
<u>WHF-05</u>	<u>G013</u>	<u>03</u>
<u>WHF-1467</u>	<u>G021</u>	<u>06</u>

- 1 WHF- – Whiting Field (required NAVFAC SE identifier)  
NNNN – 04 for Site 4 or 05 for Site 5, minimum 2 characters, up to 4 characters
- 2 G – Groundwater sample and numerical well ID  
GNN – Well number ie. 005 or 013 (nearest whole number)
- 3 Screen interval depth  
NN – Groundwater sample depth (interval spanned by screen point sampler)  
01 – Shallow  
02 – Intermediate  
03 – Deep  
04 – DD deep  
05 – 3D deep  
06 – 4D deep

Examples of the above are:

- A groundwater sample collected from monitoring well 26 at Site 5 with a shallow screened interval: location ID = WHF-5-MW-26S and the resulting sample ID would be 05G02601
- location ID = WHF-1467-MW-16D4 and the resulting sample ID would be 1467G1606
- Duplicate samples collected for quality assurance/quality control during the sampling program will be identified with a trailing “D” an example of this is as follows:
- location ID = WHF-1467-MW-16D4 and the resulting duplicate sample ID would be 1467G1606D

Other QA/QC samples collected during the field activities will be labeled as follows:

- Trip Blanks – An example of this is as follows: A second trip blank sent during the characterization would be designated WHF-TB02 the date of sampling will match the trip blank to the travel set.

- Rinsates – An example of this is as follows: first rinsate sample collected during the characterization would be designated WHF-R01.
- MS/MSD – An example of this is as follows: the second MS/MSD collected during the characterization would be designated 1467G1606**MS** or 1467G1606**MSD**.

### **3.8 SAMPLE CUSTODY**

The chain-of-custody begins with the release of the sample bottles from the laboratory and must be documented and maintained at all times. To maintain custody of the sample bottles or samples, they must be in someone's physical possession, in a locked room or vehicle, or sealed with an intact custody seal.

When possession of bottles or samples is transferred from one person to another, it will be documented in the field logbook and on the chain-of-custody.

#### **3.8.1 Sample Containers, Preservation, Holding Times, and Analyses**

Pre-preserved, certified-clean bottleware will be supplied by the subcontracted laboratory. A summary of analytical methods, bottleware requirements, preservation requirements, and sample holding times are provided in Table 3-1.

#### **3.8.2 Sample Packaging and Shipping**

Samples will be packaged and shipped according to USEPA Region 4 EISOPQAM Guidance (USEPA, 2001) and the State of Florida FS 1000, General Sampling Procedures (FDEP, 2004). The FOL will be responsible for completion of the following forms when samples are collected and prepared for shipping:

- Sample labels
- Chain-of-Custody seals
- Appropriate labels affixed to shipping coolers (e.g., "luggage" tags or "Saturday Delivery" stickers)
- Chain-of Custody Forms
- Federal Express Air Bills

### **3.9 WASTE HANDLING**

Purge water, and decontamination water will be collected and containerized in Department of Transportation-approved (Specification 17C) 55 gallon drums. Each drum will be sealed, labeled, and left at

a drum staging area pending groundwater analytical results or composite waste sample results, and will be subsequently managed in accordance with the procedures described in the NAS Whiting Field IDW Plan. This WP emphasizes management of all IDW in an environmentally responsible manner consistent with the CERCLA program, Resource Conservation and Recovery Act (RCRA) requirements, and the base's standard procedures. A NAS Whiting Field representative will sign manifests pertaining to the disposal of IDW, if required.

Health and safety equipment (e.g., gloves and ear plugs) and miscellaneous waste material generated during the field activities will be collected in trash bags and disposed in dumpsters as approved by local base personnel.

The objectives of the IDW management plan are to:

- Manage IDW to prevent contamination of uncontaminated areas and protect human health and the environment.
- Minimize volume of IDW, thereby reducing costs and the potential for human or ecological exposure to contaminated materials.
- Comply with federal and state Applicable or Relevant and Appropriate Requirements (ARARs).

### **3.10 SITE MANAGEMENT AND BASE SUPPORT**

TtNUS will perform this project with support from the Navy. Throughout the duration of the investigation activities, work at NAS Whiting Field will be coordinated through NAVFAC SE, NAS Whiting Field personnel, and the Whiting Field Facilities Manager. The primary contacts are as follows:

1. NAVFAC SE Engineer in Charge  
Ms. Sarah Reed  
(843) 820-5620
2. NAS Whiting Field Facilities  
Ron Joyner  
(850) 623-7181 ext. 140

NAS Whiting Field personnel, will aid in arranging for the following, if required:

- Personnel identification badges, vehicle passes, and/or entry permits.
- A secure staging area (approximately 1,000 square ft) for storing equipment and supplies.
- A supply (e.g., outside faucet, etc.) of potable water for equipment cleaning, etc.
- Escorts for contract personnel working in secured areas.

- A decontamination area and waste staging area located adjacent to or near the study area.

The project will be staffed with personnel from the TtNUS South Region (Tallahassee, Tampa, and/or Deerfield Beach). During field activities, TtNUS will provide a staff geologist and equipment technician(s).

Mr. Richard May, of the TtNUS Tallahassee office is the Task Order Manager (TOM) for CTO 0064 and will be the primary point of contact. Mr. May can be contacted at (850) 385-9899 or e-mail richard.may@ttnus.com. He is responsible for cost and schedule control as well as technical performance. Mr. Smith will provide senior level review and oversight during field activities. Mr. Smith can be contacted at (850) 385-9899 or e-mail larry.smith@ttnus.com.

#### **4.0 DATA VALIDATION AND RI REPORT**

Formal data validation will be performed. The data will be evaluated for, but not limited to, precision, accuracy, representativeness, completeness, and comparability parameters using the USEPA CLP National Validation Functional Guidelines for Organic Data Review (USEPA, 1999), the USEPA CLP National Validation Functional Guidelines of Inorganic Data Review (USEPA, 1994), and the TtNUS SOPs. The validated data package(s) will be included in the RI.

The groundwater data generated by this investigation will be used to further define the temporal changes in Site 40 Base Wide Groundwater at NAS Whiting Field. The additional information will be compared to data collected from the same groundwater wells circa 1998 through 2000 and used to support revised conclusions and recommendations to be presented in subsequent FSs. Data previously collected will be incorporated into the human health and ecological risk assessments and the results will be published in a draft RI report. The final report will be issued upon incorporation of review comments.

## 5.0 PROJECT SCHEDULE

The proposed schedule for site characterization activities and reporting is as follows:

- Final Sampling and Analysis Plan Approval: 15 June 2007
- Investigation Fieldwork: 15 July 2007 to 15 August 2007
- Final Site Characterization Report: 30 February 2008

The above scheduled durations are approximate, based on assumed site conditions, and will be updated monthly to reflect actual progress during the project.

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TtNUS (Tetra Tech NUS, Inc.), 2001. Corporate Quality Assurance Program Manual, January 1, 2001.

TtNUS, 2002. Florida Regional Quality Assurance Manual, October 9, 2002.

TtNUS, 2004. Corporate Standard Operating Procedures, April 2004.

USEPA (United States Environmental Protection Agency), 1994. USEPA Contract Laboratory Program National Functional Guidelines For Inorganic Data Review, Office of Solid Waste and Remedial Response, Washington, District of Columbia.

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University of Florida, 2004. Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C. Center for Environmental & Human Toxicology, Gainesville, Florida, February 26, 2004.

USEPA, 2001. Environmental Investigations Standard Operating Procedure Quality Assurance Manual (EISOPQAM), Environmental Compliance Branch, Region 4, Athens, Georgia.

Table 2-1																
RI WORK PLAN FOR SITE 40																
GROUNDWATER SAMPLE LIST																
NORTH FIELD AREA																
NAS WHITING FIELD																
MILTON, FLORIDA																
Well Identification	Samples										Sampling IDs					
	BTEX	PCE	TCE	cis-DCE	VC	TAL Metals	Microbiological	Fe(III)	CO <sub>2</sub>	NO <sub>3</sub>	O <sub>2</sub>	SO <sub>4</sub>	Mg			
															Inside Diameter	Casing Elevation
															Top of Screen Depth	Bottom of Screen Depth
1	WHF-BKG-MW-1D														2	128.68
2	WHF-BKG-MW-1I														2	128.7
3	WHF-BKG-MW-1S														2	195.46
4	WHF-BKG-MW-2D														2	111.9
5	WHF-BKG-MW-2I														2	128.7
6	WHF-BKG-MW-2S														2	180.24
7	WHF-BKG-MW-3S														2	147.57
8	WHF-03-MW-1D	1	1	1	1	1	1	1	1	1	1	1	1	03G0103	2	172.97
9	WHF-03-MW-1I	1	1	1	1	1	1	1	1	1	1	1	1	03G0102	2	174.92
10	WHF-03-MW-1S	1	1	1	1	1	1	1	1	1	1	1	1	03G0101	2	172.97
11	WHF-03-MW-2D	1	1	1	1	1	1	1	1	1	1	1	1	03G0203	2	173.14
12	WHF-03-MW-2I	1	1	1	1	1	1	1	1	1	1	1	1	03G0202	2	175.37
13	WHF-03-MW-2S	1	1	1	1	1	1	1	1	1	1	1	1	03G0201	2	172.78
14	WHF-03-MW-3D	1	1	1	1	1	1	1	1	1	1	1	1	03G0303	2	175.69
15	WHF-03-MW-3I	1	1	1	1	1	1	1	1	1	1	1	1	03G0302	2	178.18
16	WHF-03-MW-3S	1	1	1	1	1	1	1	1	1	1	1	1	03G0301	2	175.23
17	WHF-03-MW-4S	1	1	1	1	1	1	1	1	1	1	1	1	03G0401	2	174.38
18	WHF-03-MW-7D	1	1	1	1	1	1	1	1	1	1	1	1	03G0703	2	173.29
19	WHF-03-MW-7I	1	1	1	1	1	1	1	1	1	1	1	1	03G0702	2	173.25
20	WHF-03-MW-7S	1	1	1	1	1	1	1	1	1	1	1	1	03G0701	2	173.27
21	WHF-04-MW-1I														2	172.45
22	WHF-07-MW-1I														2	187.75
23	WHF-1467-MW-10S														2	89.1
24	WHF-1467-MW-11P														2	156.49
25	WHF-1467-MW-12S														2	106.55
26	WHF-1467-MW-13P														2	164.57
27	WHF-1467-MW-14D3														4	180
28	WHF-1467-MW-14D4														4	180
29	WHF-1467-MW-14S	1	1	1	1	1	1	1	1	1	1	1	1	1467G1401	2	174.47
30	WHF-1467-MW-15S														2	115.5
31	WHF-1467-MW-16D3														4	177
32	WHF-1467-MW-16D4														4	177
33	WHF-1467-MW-16S														4	177.05
34	WHF-1467-MW-17D3														4	175
35	WHF-1467-MW-17S														2	115
36	WHF-1467-MW-18S	1	1	1	1	1	1	1	1	1	1	1	1	1467G1801	4	175.12
37	WHF-1467-MW-19S	1	1	1	1	1	1	1	1	1	1	1	1	1467G1901	2	169.33
38	WHF-1467-MW-1S														2	168.51
39	WHF-1467-MW-20S	1	1	1	1	1	1	1	1	1	1	1	1	1467G2001	2	172.26
40	WHF-1467-MW-21S	1	1	1	1	1	1	1	1	1	1	1	1	1467G2101	2	173.93
41	WHF-1467-MW-22S														2	172.38
42	WHF-1467-MW-23P														2	172.57
43	WHF-1467-MW-24P	1	1	1	1	1	1	1	1	1	1	1	1	1467G2401	2	169.77
44	WHF-1467-MW-26P														2	166.28
45	WHF-1467-MW-27S	1	1	1	1	1	1	1	1	1	1	1	1	1467G2701	2	173.74
46	WHF-1467-MW-28S	1	1	1	1	1	1	1	1	1	1	1	1	1467G2801	2	173.03
47	WHF-1467-MW-29S	1	1	1	1	1	1	1	1	1	1	1	1	1467G2901	2	168.96
48	WHF-1467-MW-2I	1	1	1	1	1	1	1	1	1	1	1	1	1467G0202	2	174.29
49	WHF-1467-MW-2P	1	1	1	1	1	1	1	1	1	1	1	1	1467G0201	2	157.44
50	WHF-1467-MW-30P	1	1	1	1	1	1	1	1	1	1	1	1	1467G3001	2	174.23
51	WHF-1467-MW-31S	1	1	1	1	1	1	1	1	1	1	1	1	1467G3101	2	171.21
52	WHF-1467-MW-32S														2	162.31
53	WHF-1467-MW-33P	1	1	1	1	1	1	1	1	1	1	1	1	1467G3301	4	169.86

Table 2-1																					
RI WORK PLAN FOR SITE 40																					
GROUNDWATER SAMPLE LIST																					
NORTH FIELD AREA																					
NAS WHITING FIELD																					
MILTON, FLORIDA																					
Well Identification		Samples												Sampling IDs				Inside Diameter	Casing Elevation	Top of Screen Depth	Bottom of Screen Depth
		BTEX	PCE	TCE	cis-DCE	VC	TAL Metals	Microbiological	Fe(III)	CO <sub>2</sub>	NO <sub>3</sub>	O <sub>2</sub>	SO <sub>4</sub>	Mg							
54	WHF-1467-MW-3P																	2	157.25	80	95
55	WHF-1467-MW-4S																	2	174.64	88	103
56	WHF-1467-MW-5D	1	1	1	1	1	1		1	1	1	1	1	1	1467G0503			2	171.77	148	158
57	WHF-1467-MW-5S																	2	173.27	85	100
58	WHF-1467-MW-6D																	2	166.23	97	102
59	WHF-1467-MW-6S																	2	176.54	88	103
60	WHF-1467-MW-7I																	2	158.18	124	129
61	WHF-1467-MW-7P																	2	157.48	70	85
62	WHF-1467-MW-8I																	2	168.85	112	127
63	WHF-1467-MW-8S																	2	173.24	92	107
64	WHF-1467-MW-9S	1	1	1	1	1	1		1	1	1	1	1	1	1467G0901			2	162.99	85	100
65	WHF-30-MW-2S	1	1	1	1	1	1		1	1	1	1	1	1	30G0201			2	177.27	115	130
66	WHF-30-MW-3D																	2	178.86	275	285
67	WHF-30-MW-3S																	2	179.11	119	134
68	WHF-30-MW-4S	1	1	1	1	1	1		1	1	1	1	1	1	30G0401			2	181.49	120	135
69	WHF-30-MW-5S	1	1	1	1	1	1		1	1	1	1	1	1	30G0501			2	181.89	147	157
70	WHF-32-MW-10D																	2	172.62	175	185
71	WHF-32-MW-10I																	2	172.62	145	155
72	WHF-32-MW-11P																	2	158.47	71	86
73	WHF-32-MW-12D																	2	165.13	176	186
74	WHF-32-MW-12I																	2	165.27	145	155
75	WHF-32-MW-12P																	2	165.81	76	91
76	WHF-32-MW-1S	1	1	1	1	1	1	1	1	1	1	1	1	1	32G0101			2	171.88	95	110
77	WHF-32-MW-2S	1	1	1	1	1	1		1	1	1	1	1	1	32G0201			2	172.27	95.54	110.54
78	WHF-32-MW-3D																	2	172.6	305	315
79	WHF-32-MW-3I	1	1	1	1	1	1		1	1	1	1	1	1	32G0302			2	172.6	146	156
80	WHF-32-MW-3S	1	1	1	1	1	1	1	1	1	1	1	1	1	32G0301			2	172.01	95.02	110.02
81	WHF-32-MW-4S																	2	172.29	95.25	110.25
82	WHF-32-MW-5S	1	1	1	1	1	1	1	1	1	1	1	1	1	32G0501			2	172.15	94.61	109.61
83	WHF-32-MW-6D																	2	175.27	175	185
84	WHF-32-MW-6I																	2	175.14	145	155
85	WHF-32-MW-7S	1	1	1	1	1	1		1	1	1	1	1	1	32G0701			2	173.55	98	113
86	WHF-32-MW-8D																	2	175.06	178	188
87	WHF-32-MW-8I	1	1	1	1	1	1		1	1	1	1	1	1	32G0802			2	175.08	145	155
88	WHF-32-MW-8S	1	1	1	1	1	1		1	1	1	1	1	1	32G0801			2	175.09	100	115
89	WHF-32-MW-9D																	2	177.27	175	185
90	WHF-32-MW-9I	1	1	1	1	1	1		1	1	1	1	1	1	32G0902			2	177.45	145	155
91	WHF-35-MW-1D	1	1	1	1	1	1		1	1	1	1	1	1	35G0103			2	178.16	166	176
92	WHF-35-MW-1I	1	1	1	1	1	1		1	1	1	1	1	1	35G0102			2	178.16	136	146
93	WHF-35-MW-1S	1	1	1	1	1	1		1	1	1	1	1	1	35G0101			2	178.17	101	146
94	WHF-PLJ-MW-01	1	1	1	1	1			1	1	1	1	1	1	PLJG0101			2			
Totals		45	45	45	45	45	44	5	45	45	45	45	45	45	0	0	0	0	0	0	
BTEX = Benzene, toluene, ethylbenzene, xylenes PCE = Tetrachloroethylene TCE = Trichloroethylene Cis-DCE = 1,2-Dichloroethylene VC = Vinyl Chloride Microbiologicals = microbiological fauna will be sampled for analysis. Possible analytic options include: clostridium, dehalobacter, desulfitobacterium, desulfuromonas, geobacter, sulfurospirillum, and dehalococcoides ethenogenes strain 195.																					

Table 2-2																					
RI WORK PLAN FOR SITE 40																					
GROUNDWATER SAMPLE LIST																					
SOUTH FIELD AREA																					
NAS WHITING FIELD																					
MILTON, FLORIDA																					
Well Identification		Samples												Sampling IDs		Inside Diameter	Casing Elevation	Top of Screen Depth	Bottom of Screen Depth		
		BTEX	PCE	TCE	cis-DCE	VC	TAL Metals	Microbiological	Fe(III)	CO <sub>2</sub>	NO <sub>3</sub>	O <sub>2</sub>	SO <sub>4</sub>							Mg	
1	WHF-05-MW-10D	1	1	1	1	1	1		1	1	1	1	1	1	05G1003			2	184.32	173.3	183.32
2	WHF-05-MW-10I																	2	184.11	134	144
3	WHF-05-MW-1D																	4	184.32		
4	WHF-05-MW-3I	1	1	1	1	1	1		1	1	1	1	1	1	05G0302			2	184.22	137	147
5	WHF-05-MW-8D																	2	177.86	164	174
6	WHF-05-MW-8S																	2	177.44	110	125
7	WHF-05-MW-9D																	2	175.97	170.1	180.12
8	WHF-05-MW-9S																	2	175.55	118	128
9	WHF-05-OW-1D																	2	185.8	172	177.81
10	WHF-05-OW-2S																	2	186.02	111	116
11	WHF-05-PZ-1I																	2	186	126.8	136.78
12	WHF-05-PZ-2I																	2	185.9	142	152
13	WHF-06-MW-1D																	2	177.55	170.5	180.47
14	WHF-06-MW-1S	1	1	1	1	1	1	1	1	1	1	1	1	1	06G0101			2	177.63	124	134
15	WHF-06-MW-3D	1	1	1	1	1	1		1	1	1	1	1	1	06G0303			2	175.72	108.5	123.45
16	WHF-07-MW-1I	1	1	1	1	1	1		1	1	1	1	1	1	07G0102			2	187.75	133.4	143.38
17	WHF-1466-MW-10S																	2	172.08	107	122
18	WHF-1466-MW-11P																	2	175.87	89	104
19	WHF-1466-MW-12S																	2	189.92	125	147
20	WHF-1466-MW-13S	1	1	1	1	1	1		1	1	1	1	1	1	1466G1301			2	177.31	115	130
21	WHF-1466-MW-14S																	2	181.05	120	135
22	WHF-1466-MW-15S	1	1	1	1	1	1		1	1	1	1	1	1	1466G1501			2	177.81	119	134
23	WHF-1466-MW-16S																	2	176.49	120	135
24	WHF-1466-MW-17S																	2	177.91	119	134
25	WHF-1466-MW-18S	1	1	1	1	1	1		1	1	1	1	1	1	1466G1801			2	185.58	120	135
26	WHF-1466-MW-19S	1	1	1	1	1	1		1	1	1	1	1	1	1466G1901			2	188.81	130	145
27	WHF-1466-MW-1S	1	1	1	1	1	1	1	1	1	1	1	1	1	1466G0101			2	177.79	120	135
28	WHF-1466-MW-20S	1	1	1	1	1	1		1	1	1	1	1	1	1466G2001			2	187.76	125	140
29	WHF-1466-MW-21D																	2	61.44	86	96
30	WHF-1466-MW-21I																	2	61.75	59	69
31	WHF-1466-MW-21S																	2	62.39	25	40
32	WHF-1466-MW-23D	1	1	1	1	1	1		1	1	1	1	1	1	1466G2303			2	128.14	140	150
33	WHF-1466-MW-23I	1	1	1	1	1	1		1	1	1	1	1	1	1466G2302			2	128.15	113	123
34	WHF-1466-MW-23S	1	1	1	1	1	1		1	1	1	1	1	1	1466G2301			2	128.88	80	90
35	WHF-1466-MW-25S	1	1	1	1	1	1		1	1	1	1	1	1	1466G2501			2	148	163	163
36	WHF-1466-MW-26S	1	1	1	1	1	1	1	1	1	1	1	1	1	1466G2601			2	192	210	210
37	WHF-1466-MW-27S	1	1	1	1	1	1		1	1	1	1	1	1	1466G2701			2	126	141	141
38	WHF-1466-MW-2I	1	1	1	1	1	1		1	1	1	1	1	1				2	190.03	139	144
39	WHF-1466-MW-2S																	2	180.72	105	120
40	WHF-1466-MW-3I																	2	179.75	144	149
41	WHF-1466-MW-3S	1	1	1	1	1	1		1	1	1	1	1	1	1466G0301			2	197.42	130	145
42	WHF-1466-MW-4S																	2	190.37	132	147
43	WHF-1466-MW-5S																	2	175.18	117	132
44	WHF-1466-MW-6D	1	1	1	1	1	1		1	1	1	1	1	1	1466G0603			2	173.05	180	190
45	WHF-1466-MW-6DD																	2	172.86	210	220
46	WHF-1466-MW-6I	1	1	1	1	1	1		1	1	1	1	1	1	1466G0602			2	173.06	150	160
47	WHF-1466-MW-6S																	2	173.09	115	130
48	WHF-1466-MW-7S																	2	172.26	116	132
49	WHF-1466-MW-8D																	2	172.28	180	190
50	WHF-1466-MW-8D3																	4	172	220	230
51	WHF-1466-MW-8D4																	4	172	286	296
52	WHF-1466-MW-8DD																	2	172.64	210	220
53	WHF-1466-MW-8I																	2	172.58	161	171
54	WHF-1466-MW-8S																	2	172.24	115	130
55	WHF-1466-MW-9D																	2	173.11	180	190
56	WHF-1466-MW-9D3																	4	173	216	226
57	WHF-1466-MW-9DD																	2	173.44	210	220

Table 2-2																											
RI WORK PLAN FOR SITE 40																											
GROUNDWATER SAMPLE LIST																											
SOUTH FIELD AREA																											
NAS WHITING FIELD																											
MILTON, FLORIDA																											
Well Identification		Samples												Sampling IDs						Inside Diameter	Casing Elevation	Top of Screen Depth	Bottom of Screen Depth				
		BTEX	PCE	TCE	Cis-DCE	VC	TAL Metals	Microbiological	Fe(III)	CO <sub>2</sub>	NO <sub>3</sub>	O <sub>2</sub>	SO <sub>4</sub>	Mg													
58	WHF-1466-MW-9I																							2	173.4	150	160
59	WHF-1466-MW-9S																							2	173.2	100	115
60	WHF-15-MW-1I																							2	66.35	63	73
61	WHF-15-MW-2D																							2	59.39	107.4	112.44
62	WHF-15-MW-2I	1	1	1	1	1	1		1	1	1	1	1	1	15G0203									2	60.1	58.2	63.2
63	WHF-15-MW-2S																							2	59.58	17.9	32.9
64	WHF-15-MW-3D																							2	69.44	109.5	119.48
65	WHF-15-MW-3I	1	1	1	1	1	1		1	1	1	1	1	1	15G0302									2	69.69	77.83	87.83
66	WHF-15-MW-3S																							2	69.29	22.94	37.94
67	WHF-15-MW-4S																							2	143.29	94.15	109.15
68	WHF-15-MW-5D	1	1	1	1	1	1	1	1	1	1	1	1	1	15G0503									2	106.11	118	128
69	WHF-15-MW-5I	1	1	1	1	1	1	1	1	1	1	1	1	1	15G0502									2	105.17	88	98
70	WHF-15-MW-5S																							2	104.14	58.18	68.18
71	WHF-15-MW-6D																							2	75.08	113.4	123.36
72	WHF-15-MW-6S																							2	74.29	28.73	43.73
73	WHF-15-MW-7D	1	1	1	1	1	1		1	1	1	1	1	1	15G0703									2	119.49	137	147
74	WHF-15-MW-7I	1	1	1	1	1	1		1	1	1	1	1	1	15G0702									2	120.17	111	121
75	WHF-15-MW-7S																							2	120.45	73	88
76	WHF-15-MW-8D	1	1	1	1	1	1		1	1	1	1	1	1	15G0803									2	79.08	105	115
77	WHF-15-MW-8D3																							4	78.38	120	130
78	WHF-15-MW-8I	1	1	1	1	1	1		1	1	1	1	1	1	15G0802									2	79.48	75	85
79	WHF-15-MW-8S																							2	79.67	40	55
80	WHF-16-MW-1I																							2	50.04	33	43
81	WHF-16-MW-2D	1	1	1	1	1	1		1	1	1	1	1	1	16G0203									2	80.6	120.1	130.14
82	WHF-16-MW-2I	1	1	1	1	1	1		1	1	1	1	1	1	16G0202									2	82.19	69.2	74.2
83	WHF-16-MW-2S																							2	83.66	34.8	49.8
84	WHF-16-MW-3D																							2	51.4	108.1	118.08
85	WHF-16-MW-3I	1	1	1	1	1	1		1	1	1	1	1	1	16G0302									2	51.31	47.87	52.87
86	WHF-16-MW-3II																							2	51.22	73.91	78.91
87	WHF-16-MW-3S																							2	51.69	8.25	23.25
88	WHF-16-MW-4D	1	1	1	1	1	1		1	1	1	1	1	1	16G0403									2	52.87	102.5	122.54
89	WHF-16-MW-4II	1	1	1	1	1	1		1	1	1	1	1	1	16G0402									2	53.01	54.8	64.8
90	WHF-16-MW-4S																							2	54.79	7.38	22.38
91	WHF-16-MW-5S																							2	37.54	3.5	13.5
92	WHF-16-MW-6D	1	1	1	1	1	1		1	1	1	1	1	1	16G0603									2	56.77	52	62
93	WHF-16-MW-6S																							2	56.57	11	22
94	WHF-16-MW-7D	1	1	1	1	1	1		1	1	1	1	1	1	16G0703									2	38.05	65	75
95	WHF-16-MW-7I	1	1	1	1	1	1		1	1	1	1	1	1	16G0702									2	38.17	36.5	46.5
96	WHF-16-MW-7S																							2	38.27	5	15
97	WHF-29-MW-1S																							2	193.53	124.5	139.48
98	WHF-29-MW-2S																							2	191.52	121.9	136.9
99	WHF-29-MW-3S																							2	194.02	124.6	139.64
100	WHF-29-MW-4S																							2	195.78	124.1	139.1
101	WHF-29-MW-5S																							2	193.47	117.1	132.14
102	WHF-30-MW-2S	1	1	1	1	1	1		1	1	1	1	1	1	30G0201									2	177.27	115	130
103	WHF-30-MW-3D																							2	178.86	275	285
104	WHF-30-MW-3S	1	1	1	1	1	1		1	1	1	1	1	1	30G0301									2	179.11	119	134
105	WHF-30-MW-4S	1	1	1	1	1	1		1	1	1	1	1	1	30G0401									2	181.49	120	135
106	WHF-30-MW-5S	1	1	1	1	1	1		1	1	1	1	1	1	30G0501									2	181.89	147	157
107	WHF-33-MW-1S	1	1	1	1	1	1		1	1	1	1	1	1	33G0101									2	180.58	112.4	127.44
108	WHF-33-MW-2S																							2	181.48	113	128
109	WHF-33-MW-3S	1	1	1	1	1	1	1	1	1	1	1	1	1	33G0301									2	181.79	113.5	128.5
110	WHF-33-MW-4S	1	1	1	1	1	1		1	1	1	1	1	1	33G0401									2	180.36	112.9	127.94
111	WHF-33-MW-5S																							2	178.39	110	125
	Totals	44	44	44	44	44	44	6	44	44	44	44	44	44	0	0	0	0	0	0	0	0					
Notes:																											
BTEX = Benzene, toluene, ethylbenzene, xylenes												Target Analyte Lists = 23 metals															
PCE = Tetrachloroethylene																											
TCE = Trichloroethylene																											
Cis-DCE = 1,2-Dichloroethylene																											
VC = Vinyl chloride																											
Microbiologicals = Naturally existing microbiological fauna will be sampled for analysis. Possible analytic options include: clostridium, dehalobacter, desulfitobacterium, desulfuromonas, geobacter, sulfurospirillum, and dehalococcoides ethenogenes strain 195.																											

TABLE 2-3																			
WELL ABANDONMENT TABLE																			
RI WORK PLAN FOR SITE 40																			
SITE 40 BASE-WIDE GROUNDWATER																			
NAS WHITING FIELD																			
MILTON, FLORIDA																			
Well Identification	Recommendation	Ballards	Abandoned	Phase 1							Phase 2							Inside Diameter	
				Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well	Linear Ft of 4 " ID well	Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4		Linear Ft of 2 " ID well
WHF-01-MW-1I	Abandon: Site LUC	1		1							123								4
WHF-01-MW-1S	Abandon: Site LUC	1	1							75.4									2
WHF-01-MW-2S	Abandon: Site LUC	1	1							78.8									2
WHF-01-MW-3S	Abandon: Site LUC	1	1							87									2
WHF-01-MW-4S	Abandon: Site LUC	1	1							79									2
WHF-01-MW-5S	Abandon: Site LUC	1	1							85									2
WHF-02-MW-1S	Retain: site under investigation	1	1									1					87.42		2
WHF-02-MW-2S	Retain: site under investigation	1	1									1					91.7		2
WHF-02-MW-3S	Retain: site under investigation	1	1									1					91.6		2
WHF-02-MW-4S	Retain: site under investigation											1					92		2
WHF-03-MW-1D	Retain: site under investigation												1				180.29		4
WHF-03-MW-1I	Retain: site under investigation												1				153		2
WHF-03-MW-1S	Retain: site under investigation											1					123.22		2
WHF-03-MW-2D	Retain: site under investigation													1			176.17		2
WHF-03-MW-2I	Retain: site under investigation												1				153.2		2
WHF-03-MW-2S	Retain: site under investigation											1					114.12		2
WHF-03-MW-3D	Retain: site under investigation													1			180.57		2
WHF-03-MW-3I	Retain: site under investigation												1				154.22		2
WHF-03-MW-3S	Retain: site under investigation											1					110.08		2
WHF-03-MW-4S	Retain: site under investigation											1					121.45		2
WHF-03-MW-7D	Retain: site under investigation													1			180.54		2
WHF-03-MW-7I	Retain: site under investigation												1				139.92		2
WHF-03-MW-7S	Retain: site under investigation											1					123.8		2
WHF-04-MW-1I	Retain: site under investigation												1				153.07		2
WHF-05-MW-10D	Retain: site under investigation									183.3									2
WHF-05-MW-10I	Retain: site under investigation									144.7									2
WHF-05-MW-1D	Retain: site under investigation																		2
WHF-05-MW-3I	Retain: site under investigation									150									2
WHF-05-MW-8D	Retain: site under investigation									174.2									2
WHF-05-MW-8S	Retain: site under investigation									128.2									2
WHF-05-MW-9D	Abandon: Site closed or NA not DG	1	1							130									2
WHF-05-MW-9S	Abandon: Site closed or NA not DG	1	1							116									2
WHF-05-OW-1D	Retain: site under investigation									177.8									2
WHF-05-OW-2S	Retain: site under investigation									116									2
WHF-05-PZ-1I	Retain: site under investigation									136.8									2
WHF-05-PZ-2I	Retain: site under investigation									152									2
WHF-06-MW-1D	Retain: site under investigation									180.5									2
WHF-06-MW-1S	Retain: site under investigation									134.3									2
WHF-06-MW-3D	Retain: site under investigation									123.5									2
WHF-07-MW-1I	Retain: site under investigation												1				143.38		2
WHF-08-MW-1D	Abandon: Site LUC	1	1		1						181								4
WHF-09-MW-1S	Abandon: Site LUC	1	1	1							300								4
WHF-09-MW-2S	Abandon: Site LUC	1	1	1							124								4
WHF-09-MW-3S	Abandon: Site LUC	1	1	1						110									2
WHF-10-MW-1S	Abandon: Site NA	1	1	1						82									2
WHF-10-MW-2S	Abandon: Site NA	1	1	1						110									2
WHF-11-MW-1I	Abandon: Site NA	1	1		1						128								4
WHF-11-MW-1S	Abandon: Site NA	1	1	1						57									2
WHF-11-MW-2I	Abandon: Site NA	1	1		1						100								4
WHF-11-MW-3S	Abandon: Site NA	1	1	1							120								4
WHF-11-MW-4P	Abandon: Site NA	1	1	1						87									2
WHF-11-MW-4S	Abandon: Site NA	1	1	1						78									2
WHF-12-MW-1I	Abandon: Site NA			Unable to locate						113.4									2
WHF-12-MW-2S	Abandon: Site NA			Unable to locate						85									2
WHF-13-MW-1D	Abandon: Site LUC	1	1			1				72									2
WHF-13-MW-1I	Abandon: Site LUC	1	1		1					68									2
WHF-13-MW-1S	Abandon: Site LUC	1	1	1						118									2
WHF-13-MW-2S	Abandon: Site LUC	1	1	1							120								4
WHF-13-MW-3D3	Abandon: Site LUC	1	1					1			100								4
WHF-13-MW-3S	Abandon: Site LUC	1	1	1						40									2

TABLE 2-3																				
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RI WORK PLAN FOR SITE 40																				
SITE 40 BASE-WIDE GROUNDWATER																				
NAS WHITING FIELD																				
MILTON, FLORIDA																				
Well Identification	Recommendation	Ballards	Abandoned	Phase 1								Phase 2							Inside Diameter	
				Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well	Linear Ft of 4 " ID well	Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well		Linear Ft of 4 " ID well
WHF-13-MW-4S	Abandon: Site LUC	1	1	1						45										2
WHF-13-MW-5S	Abandon: Site LUC	1	1	1						120										2
WHF-1438-MW-1S	Retain: site under investigation											1						112.5		2
WHF-1438-MW-2D	Retain: site under investigation												1					153		2
WHF-1438-MW-2S	Retain: site under investigation											1						122		2
WHF-1438-MW-3S	Retain: site under investigation											1						112		2
WHF-1438-MW-4S	Retain: site under investigation											1						117		2
WHF-1438-MW-5S	Retain: site under investigation											1						117		2
WHF-1438-MW-6S	Retain: site under investigation											1						116		2
WHF-1438-MW-7S	Retain: site under investigation											1						120		2
WHF-1466-MW-10S	Retain: site under investigation											1						122		2
WHF-1466-MW-11P	Retain: site under investigation											1						104		2
WHF-1466-MW-12S	Retain: site under investigation											1						147		2
WHF-1466-MW-13S	Retain: site under investigation											1						130		2
WHF-1466-MW-14S	Retain: site under investigation											1						135		2
WHF-1466-MW-15S	Retain: site under investigation											1						135		2
WHF-1466-MW-16S	Retain: site under investigation											1						135		2
WHF-1466-MW-17S	Retain: site under investigation											1						134		2
WHF-1466-MW-18S	Retain: site under investigation											1						135		2
WHF-1466-MW-19S	Retain: site under investigation											1						145		2
WHF-1466-MW-1S	Retain: site under investigation											1						135		2
WHF-1466-MW-20S	Retain: site under investigation											1						140		2
WHF-1466-MW-21D	Abandon: south or east of flow path	1	1			1				98										2
WHF-1466-MW-21I	Abandon: south or east of flow path	1	1			1				40										2
WHF-1466-MW-21S	Abandon: south or east of flow path	1	1	1						70										2
WHF-1466-MW-22D	Abandon: south or east of flow path	1	1			1				140										2
WHF-1466-MW-22I	Abandon: south or east of flow path	1	1			1				102										2
WHF-1466-MW-22S	Abandon: south or east of flow path	1	1	1						108										2
WHF-1466-MW-23D	Retain: site under investigation													1				152		2
WHF-1466-MW-23I	Retain: site under investigation													1				123		2
WHF-1466-MW-23S	Retain: site under investigation											1						90		2
WHF-1466-MW-24D3	Abandon: north of flow path	1	1					1		300										4
WHF-1466-MW-25D3	Abandon: north of flow path		1					1		209										4
WHF-1466-MW-2I	Retain: site under investigation													1				144		2
WHF-1466-MW-2S	Retain: site under investigation											1						120		2
WHF-1466-MW-3I	Retain: site under investigation													1				149		2
WHF-1466-MW-3S	Retain: site under investigation											1						145		2
WHF-1466-MW-4S	Retain: site under investigation											1						151		2
WHF-1466-MW-5S	Retain: site under investigation											1						132		2
WHF-1466-MW-6D	Retain: site under investigation													1				190		2
WHF-1466-MW-6DD	Retain: site under investigation														1			220		2
WHF-1466-MW-6I	Retain: site under investigation													1				160		2
WHF-1466-MW-6S	Retain: site under investigation											1						131		2
WHF-1466-MW-7S	Retain: site under investigation											1						132		2
WHF-1466-MW-8D	Retain: site under investigation													1				190		2
WHF-1466-MW-8D3	Retain: site under investigation															1			230	4
WHF-1466-MW-8D4	Retain: site under investigation																1		376	4
WHF-1466-MW-8DD	Retain: site under investigation														1			220		2
WHF-1466-MW-8I	Retain: site under investigation													1				171		2
WHF-1466-MW-8S	Retain: site under investigation											1						131		2
WHF-1466-MW-9D	Retain: site under investigation													1				190		2
WHF-1466-MW-9D3	Retain: site under investigation															1			226	4
WHF-1466-MW-9DD	Retain: site under investigation														1			220		2
WHF-1466-MW-9I	Retain: site under investigation													1				160		2
WHF-1466-MW-9S	Retain: site under investigation											1						116		2
WHF-1467-MW-10S	Retain: site under investigation											1						82		2
WHF-1467-MW-11P	Retain: site under investigation											1						90		2
WHF-1467-MW-12S	Retain: site under investigation											1						83		2
WHF-1467-MW-13P	Retain: site under investigation											1						90		2
WHF-1467-MW-14D3	Retain: site under investigation															1			250	4

TABLE 2-3																				
WELL ABANDONMENT TABLE																				
RI WORK PLAN FOR SITE 40																				
SITE 40 BASE-WIDE GROUNDWATER																				
NAS WHITING FIELD																				
MILTON, FLORIDA																				
Well Identification	Recommendation	Ballards	Abandoned	Phase 1								Phase 2							Inside Diameter	
				Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well	Linear Ft of 4 " ID well	Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well		Linear Ft of 4 " ID well
WHF-1467-MW-14D4	Retain: site under investigation																1		356	4
WHF-1467-MW-14S	Retain: site under investigation										1							110		2
WHF-1467-MW-15S	Retain: site under investigation										1							108		2
WHF-1467-MW-16D3	Retain: site under investigation													1					222	4
WHF-1467-MW-16D4	Retain: site under investigation															1			350	4
WHF-1467-MW-16S	Retain: site under investigation										1							115		4
WHF-1467-MW-17D3	Retain: site under investigation													1					250	4
WHF-1467-MW-17S	Retain: site under investigation										1							106		2
WHF-1467-MW-18S	Retain: site under investigation										1							115		4
WHF-1467-MW-19S	Retain: site under investigation										1							105		2
WHF-1467-MW-1S	Retain: site under investigation										1							97		2
WHF-1467-MW-20S	Retain: site under investigation										1							110		2
WHF-1467-MW-21S	Retain: site under investigation										1							111		2
WHF-1467-MW-22S	Retain: site under investigation										1							103		2
WHF-1467-MW-23P	Retain: site under investigation										1							101		2
WHF-1467-MW-24P	Retain: site under investigation										1							100		2
WHF-1467-MW-26P	Retain: site under investigation										1							90		2
WHF-1467-MW-27S	Retain: site under investigation										1							116		2
WHF-1467-MW-28S	Retain: site under investigation										1							106		2
WHF-1467-MW-29S	Retain: site under investigation										1							100		2
WHF-1467-MW-2I	Retain: site under investigation											1						124		2
WHF-1467-MW-2P	Retain: site under investigation										1							85		2
WHF-1467-MW-30P	Retain: site under investigation										1							102.5		2
WHF-1467-MW-31S	Retain: site under investigation										1							125		2
WHF-1467-MW-32S	Retain: site under investigation										1									2
WHF-1467-MW-33P	Retain: site under investigation										1							84		4
WHF-1467-MW-3P	Retain: site under investigation										1							95		2
WHF-1467-MW-4S	Retain: site under investigation										1							103		2
WHF-1467-MW-5D	Retain: site under investigation											1						158		2
WHF-1467-MW-5S	Retain: site under investigation										1							100		2
WHF-1467-MW-6D	Retain: site under investigation											1						102		2
WHF-1467-MW-6S	Retain: site under investigation										1							103		2
WHF-1467-MW-7I	Retain: site under investigation											1						129		2
WHF-1467-MW-7P	Retain: site under investigation										1							85		2
WHF-1467-MW-8I	Retain: site under investigation											1						127		2
WHF-1467-MW-8S	Retain: site under investigation										1							107		2
WHF-1467-MW-9S	Retain: site under investigation										1							100		2
WHF-1485C-MW1S	Abandon: NA	1	1	1						92		1						120		2
WHF-14-MW-1I	Abandon: NA	1	1		1						102									4
WHF-14-MW-1S	#30 ?																			
WHF-14-MW-2S	Abandon: NA	1	1	1						95										2
WHF-14-MW-3S	Abandon: NA		1	1						108										2
WHF-15-MW-1I	Retain: in flow path of SF plume											1						73.2		2
WHF-15-MW-2D	Retain: in flow path of SF plume												1					112.44		2
WHF-15-MW-2I	Retain: in flow path of SF plume											1						63.2		2
WHF-15-MW-2S	Retain: in flow path of SF plume										1							32.9		2
WHF-15-MW-3D	Retain: in flow path of SF plume												1					119.48		2
WHF-15-MW-3I	Retain: in flow path of SF plume											1						87.83		2
WHF-15-MW-3S	Retain: in flow path of SF plume										1							37.94		2
WHF-15-MW-4S	Retain: in flow path of SF plume										1							109.15		2
WHF-15-MW-5D	Retain: in flow path of SF plume												1					129		2
WHF-15-MW-5I	Retain: in flow path of SF plume											1						98		2
WHF-15-MW-5S	Retain: in flow path of SF plume										1							68.18		2
WHF-15-MW-6D	Retain: in flow path of SF plume												1					123.36		2
WHF-15-MW-6S	Retain: in flow path of SF plume										1							43.73		2
WHF-15-MW-7D	Retain: in flow path of SF plume												1					148		2
WHF-15-MW-7I	Retain: in flow path of SF plume											1						121		2
WHF-15-MW-7S	Retain: in flow path of SF plume										1							89		2
WHF-15-MW-8D	Retain: in flow path of SF plume												1					117		2
WHF-15-MW-8D3	Retain: in flow path of SF plume													1				130		2

TABLE 2-3																				
WELL ABANDONMENT TABLE																				
RI WORK PLAN FOR SITE 40																				
SITE 40 BASE-WIDE GROUNDWATER																				
NAS WHITING FIELD																				
MILTON, FLORIDA																				
Well Identification	Recommendation	Ballards	Abandoned	Phase 1								Phase 2								
				Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well	Linear Ft of 4 " ID well	Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well	Linear Ft of 4 " ID well	Inside Diameter
WHF-15-MW-8I	Retain: in flow path of SF plume											1						85		2
WHF-15-MW-8S	Retain: in flow path of SF plume											1						55		2
WHF-16-MW-1I	Retain: in flow path of SF plume											1						43		2
WHF-16-MW-2D	Retain: in flow path of SF plume																	130.14		2
WHF-16-MW-2I	Retain: in flow path of SF plume												1					74.2		2
WHF-16-MW-2S	Retain: in flow path of SF plume											1						49.8		2
WHF-16-MW-3D	Retain: in flow path of SF plume													1				118.08		2
WHF-16-MW-3I	Retain: in flow path of SF plume												1					52.87		2
WHF-16-MW-3II	Retain: in flow path of SF plume												1					78.91		2
WHF-16-MW-3S	Retain: in flow path of SF plume											1						23.25		2
WHF-16-MW-4D	Retain: in flow path of SF plume													1				122.54		2
WHF-16-MW-4II	Retain: in flow path of SF plume												1					64.8		2
WHF-16-MW-4S	Retain: in flow path of SF plume											1						22.38		2
WHF-16-MW-5S	Retain: in flow path of SF plume											1						13.5		2
WHF-16-MW-6D	Retain: in flow path of SF plume													1				62		2
WHF-16-MW-6S	Retain: in flow path of SF plume											1						22		2
WHF-16-MW-7D	Retain: in flow path of SF plume													1				75		2
WHF-16-MW-7D3	Abandon: different aquifer																			4
WHF-16-MW-7D4	Abandon: different aquiferArtesian		1					1												4
WHF-16-MW-7I	Retain: in flow path of SF plume												1					46.5		2
WHF-16-MW-7S	Retain: in flow path of SF plume		1	1								1						15		2
WHF-17-MW-1I	Retain: EC and LUC												1					159		2
WHF-17-MW-1S	Retain: EC and LUC											1						115		2
WHF-17-MW-2S	Retain: EC and LUC											1						122		2
WHF-17-MW-3S	Retain: EC and LUC											1						126.5		2
WHF-18-MW-1I	Retain: EC and LUC													1				120.2		2
WHF-18-MW-2S	Retain: EC and LUC											1						107.86		2
WHF-18-MW-3S	Retain: EC and LUC											1						112.9		2
WHF-2832-MW10P	Abandon by others: RAP May 2007																	20		2
WHF-2832-MW11P	Abandon by others: RAP May 2007																	18		2
WHF-2832-MW13P	Abandon		1	1														23.5		2
WHF-2832-MW1P	Abandon by others: RAP May 2007																	20		2
WHF-2832-MW1S	Abandon by others: RAP May 2007									122								122		2
WHF-2832-MW2P	Abandon by others: RAP May 2007																	19.81		2
WHF-2832-MW2S	Abandon		1	1						122								122		2
WHF-2832-MW3P	Abandon by others: RAP May 2007																	19.62		2
WHF-2832-MW3S	Abandon by others: RAP May 2007									124.7								124.69		2
WHF-2832-MW4P	Abandon by others: RAP May 2007																	14.46		2
WHF-2832-MW4S	Abandon by others: RAP May 2007									124.5								124.5		2
WHF-2832-MW5P	Abandon by others: RAP May 2007																	18		2
WHF-2832-MW6P	Abandon by others: RAP May 2007																	19.74		2
WHF-2832-MW7P	Abandon by others: RAP May 2007																	19.65		2
WHF-2832-MW8P	Abandon by others: RAP May 2007																	18.85		2
WHF-2832-MW9P	Abandon by others: RAP May 2007																			2
WHF-2894-MW-1I	Retain: under investigation												1					114		4
WHF-2894-MW-1S	Retain: under investigation											1						96		4
WHF-2894-MW-2I	Retain: under investigation												1					117		4
WHF-2894-MW-2S	Retain: under investigation											1						86		4
WHF-2894-MW-3S	Retain: under investigation											1						86		4
WHF-2894-MW-5S	Retain: under investigation											1						96		4
WHF-2894-MW-6S	Retain: under investigation	1								88								96		4
WHF-2894-MW-7S	Retain: under investigation											1						85		4
WHF-29-MW-1S	Abandon:NW of SF plume site NFA	1	1	1						106										2
WHF-29-MW-2S	Abandon:NW of SF plume site NFA	1	1	1						129										2
WHF-29-MW-3S	Abandon:NW of SF plume site NFA	1	1	1						173										2
WHF-29-MW-4S	Abandon:NW of SF plume site NFA	1	1	1						116										2
WHF-29-MW-5S	Abandon:NW of SF plume site NFA	1	1	1						58										2
WHF-3054-MW-1S	Retain: in SFP											1						125		2
WHF-3054-MW-2S	Retain: in SFP											1						117.5		2
WHF-30-MW-2S	Retain: in SFP											1						130		2

TABLE 2-3																				
WELL ABANDONMENT TABLE																				
RI WORK PLAN FOR SITE 40																				
SITE 40 BASE-WIDE GROUNDWATER																				
NAS WHITING FIELD																				
MILTON, FLORIDA																				
Well Identification		Recommendation		Ballards	Abandoned	Phase 1								Phase 2						
						Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well	Linear Ft of 4 " ID well	Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well
WHF-30-MW-3D	Retain: in SFP																			
WHF-30-MW-3S	Retain: in SFP												1	1					134.6	2
WHF-30-MW-4S	Retain: in SFP												1						135.44	2
WHF-30-MW-5S	Retain: in SFP												1						157.53	2
WHF-31-MW-1S	Abandon: Site NFA	1	1							115.4										2
WHF-31-MW-2S	Abandon: Site NFA	1	1							85										2
WHF-31-MW-3S	Abandon: Site NFA	1	1							74										2
WHF-31-MW-4D	Abandon: Site NFA	1			1					82										2
WHF-31-MW-4I	Abandon: Site NFA	1		1						140										2
WHF-31-MW-4S	Abandon: Site NFA	1	1							102										2
WHF-31-MW-5S	Abandon: Site NFA: 31F	1	1							110										2
WHF-31-MW-6S	Abandon: Site NFA: 31B	1	1							108										2
WHF-31-MW-7S	Abandon: Site NFA: 31E	1	1	1						110										2
WHF-31-MW-8S	Abandon: Site NFA: 31D	1	1							110										2
WHF-32-MW-10D	Retain: in NFP													1					185	2
WHF-32-MW-10I	Retain: in NFP												1						155	2
WHF-32-MW-11P	Retain: in NFP												1						86	2
WHF-32-MW-12D	Retain: in NFP													1					186.4	2
WHF-32-MW-12I	Retain: in NFP												1						155	2
WHF-32-MW-12P	Retain: in NFP												1						102	2
WHF-32-MW-1S	Retain: in NFP												1						110.34	2
WHF-32-MW-2S	Retain: in NFP												1						110.54	2
WHF-32-MW-3D	Retain: in NFP													1					372	2
WHF-32-MW-3I	Retain: in NFP													1					156	2
WHF-32-MW-3S	Retain: in NFP												1						110.02	2
WHF-32-MW-4S	Retain: in NFP												1						110.25	2
WHF-32-MW-5S	Retain: in NFP												1						109.61	2
WHF-32-MW-6D	Retain: in NFP													1					185	2
WHF-32-MW-6I	Retain: in NFP													1					155	2
WHF-32-MW-7S	Retain: in NFP												1						113	2
WHF-32-MW-8D	Retain: in NFP													1					188	2

TABLE 2-3																				
WELL ABANDONMENT TABLE																				
RI WORK PLAN FOR SITE 40																				
SITE 40 BASE-WIDE GROUNDWATER																				
NAS WHITING FIELD																				
MILTON, FLORIDA																				
Well Identification	Recommendation	Ballards	Abandoned	Phase 1								Phase 2							Inside Diameter	
				Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well	Linear Ft of 4 " ID well	Shallow = S	Intermediate = I	Deep D	2 Deep =DD	3 Deep = D3	4 Deep = D4	Linear Ft of 2 " ID well		Linear Ft of 4 " ID well
WHF-32-MW-8I	Retain: in NFP											1	1					155		2
WHF-32-MW-8S	Retain: in NFP											1						115		2
WHF-32-MW-9D	Retain: in NFP												1					186		2
WHF-32-MW-9I	Retain: in NFP												1					155		2
WHF-33-MW-1S	Retain: in SFP											1						127.44		2
WHF-33-MW-2S	Retain: in SFP											1						128		2
WHF-33-MW-3S	Retain: in SFP											1						128.5		2
WHF-33-MW-4S	Retain: in SFP											1						127.94		2
WHF-33-MW-5S	Retain: in SFP											1						125.9		2
WHF-35-MW-1D	Abandon: Site LUC Soil	1			1					180										2
WHF-35-MW-1I	Abandon: Site LUC Soil	1			1					129										2
WHF-35-MW-1S	Abandon: Site LUC Soil	1	1							110										2
WHF-35-MW-2D	Abandon: Site LUC Soil	1	1			1				67										2
WHF-35-MW-2I	Abandon: Site LUC Soil	1			1					113										2
WHF-35-MW-2S	Abandon: Site LUC Soil	1	1							91										2
WHF-36-MW-1D	Abandon: Site Closed	1	1			1				133										2
WHF-36-MW-1I	Abandon: Site Closed	1	1			1				110										2
WHF-36-MW-1S	Abandon: Site Closed	1	1	1						67										2
WHF-37-MW-1I	Abandon: Site Closed NA									140										2
WHF-37-MW-1S	Abandon: Site Closed NA									118										2
WHF-38-MW-1S	Abandon: Site NFA	1	1							103										2
WHF-38-MW-2S	Abandon: Site NFA	1	1							105										2
WHF-38-MW-3S	Abandon: Site NFA	1	1							102										2
WHF-38-MW-4S	Abandon: Site NFA	1	1							102										2
WHF-BKG-MW-1D	Retain												1					179.3		2
WHF-BKG-MW-1I	Retain												1					140.3		2
WHF-BKG-MW-1S	Retain											1						121.6		2
WHF-BKG-MW-2D	Retain												1					174		2
WHF-BKG-MW-2I	Retain												1					144.2		2
WHF-BKG-MW-2S	Retain											1						109.22		2
WHF-BKG-MW-3S	Retain											1						80.5		2
WHF-OW-MW-1D	Abandon: West of Clear Creek	1				1				77										2
WHF-OW-MW-1D3	Abandon: West of Clear Creek																			4
WHF-OW-MW-1D4	Abandon: West of Clear Creek Artesian	1								1										4
WHF-OW-MW-1I	Abandon: West of Clear Creek	1			1					47										2
WHF-OW-MW-1S	Abandon: West of Clear Creek	1	1							16										2
WHF-OW-MW-2S	Abandon: West of Clear Creek	1	1							77										2
WHF-OW-MW-3D	Abandon: West of Clear Creek	1				1				117										2
WHF-OW-MW-3I	Abandon: West of Clear Creek	1			1					81										2
WHF-OW-MW-3S	Abandon: West of Clear Creek	1	1							57										2
WHF-OW-MW-4S	Abandon: West of Clear Creek	1	1							77										2
WHF-OW-MW-5D	Abandon: West of Clear Creek																			2
WHF-OW-MW-5D3	Abandon: West of Clear Creek																			4
WHF-OW-MW-5D4	Abandon: West of Clear Creek Artesian	1								1										4
WHF-OW-MW-5I	Abandon: West of Clear Creek																			2
WHF-OW-MW-5S	Abandon: West of Clear Creek																			2
Totals:		41	85	54	13	10	0	3	3	8973	1907	117	39	30	3	6	3	23557	2260	
Total Phase 1 Wells		85		83		Total phase 2 Wells												198		
Notes: LUC = land use controls NA = not available SF = south field EC = environmental controls RAP = Remedial Action Plan NFA = No Further Action NFP = north field plume SFP = south field plume DG = down gradient * 1: Adjacent building removed, likely wells destroyed during process.																				

**TABLE 2-4**  
**GROUNDWATER ANALYTICAL SUMMARY**  
**NORTH FIELD PLUME**  
  
**NAS WHITING FIELD**  
**MILTON, FLORIDA**

<b>Analyte</b>	<b>Proposed Method <sup>(1)</sup></b>	<b>Environmental Samples</b>	<b>Duplicate Samples</b>	<b>MS/MSD</b>	<b>Rinsate Blanks</b>	<b>Field Blanks</b>	<b>Trip Blanks</b>	<b>Total Samples</b>
BTEX, PCE, TCE, cis-DCE, EDB and VC	8260B and 504.1	51	5	3	5	3	10	<b>77</b>
Microorganisms	Various	5						<b>5</b>
Total Arsenic, Cadmium, Chromium, and Lead	6010B or 6020	51	5	3	5	3		<b>67</b>

**NOTES:**

BTEX = Benzene, toluene, ethylbenzene, and xylene

PCE =Tetrachloroethylene

TCE = Trichloroethylene

Cis-DCE = 1,2-Dichloroethylene

EDB = 1,2-Dibromothane

VC = Vinyl Chloride

MS/MSD = Matrix Spike/Matrix Spike Duplicate

Microorganisms = to be determined options include; Clostridium, dehalobacter, desulfitobacterium, Desulfuromonas, Geobacter, Sulfurospirillum, Dehalococcoides ethenogenes strain 195

<sup>(1)</sup> EPA Method SW-846 series: reflects FDEP 62-770 or 62-761, F.A.C. requirements.

**TABLE 2-5**  
  
**GROUNDWATER ANALYTICAL SUMMARY**  
**SOUTH FIELD PLUME**  
  
**NAS WHITING FIELD**  
**MILTON, FLORIDA**

<b>Analyte</b>	<b>Proposed Method <sup>(1)</sup></b>	<b>Environmental Samples</b>	<b>Duplicate Samples</b>	<b>MS/MSD</b>	<b>Rinsate Blanks</b>	<b>Field Blanks</b>	<b>Trip Blanks</b>	<b>Total Samples</b>
BTEX, PCE, TCE, cis-DCE, EDB and VC	8260B and 504.1	51	5	3	5	3	10	77
Microorganisms	Various	5						5
Total Arsenic, Cadmium, Chromium, and Lead	6010B or 6020	51	5	3	5	3		67

**NOTES:**

BTEX = Benzene, toluene, ethylbenzene, and xylene

PCE =Tetrachloroethylene

TCE = Trichloroethylene

Cis-DCE = 1,2 –Dichloroethylene

EDB = 1,2-Dibromothane

VC = Vinyl Chloride

MS/MSD = Matrix Spike/Matrix Spike Duplicate

Microorganisms = to be determined, options include; Clostridium, dehalobacter, desulfitobacterium, Desulfuromonas, Geobacter, Sulfurospirillum, Dehalococcoides ethenogenes strain 195

<sup>(1)</sup> EPA Method SW-846 series: reflects FDEP 62-770 or 62-761, F.A.C. requirements.

**TABLE 2-6**  
**SUMMARY OF GROUNDWATER ANALYTICAL REQUIREMENTS**  
**NAS WHITING FIELD**  
**MILTON, FLORIDA**

<b>Analysis</b>	<b>Analytical Method</b>	<b>Sample Volume<sup>(1)</sup></b>	<b>Bottleware</b>	<b>Preservation</b>	<b>Holding Time<sup>(2)</sup></b>
CLP TCL VOCs	SW-846 8260B	3 x 40 mL	Glass, plastic screw cap, Teflon™-lined	Cool to 4°C, HCl to pH<2	14 days from sampling to analysis
CLP TAL Inorganics	EPA SW-846 6010B or 6020	200 mL	Plastic, plastic screw cap, Teflon™-lined	Cool to 4°C, HNO <sub>3</sub> to pH<2	Within 180 days
EDB	USEPA Method 504.1	3x40 mL	Glass, plastic screw cap, Teflon™-lined	Cool to 4°C, sodium thiosulfate needed to react with residual chlorine	14 days
Microbiologicals	Analysis of DNA	Lab dependant	plastic with flow through filter medium	Cool to 4°C, HCL to pH<2	NA

**NOTES:**

<sup>(1)</sup> Sample volume may vary based on laboratory requirements.

<sup>(2)</sup> Holding times are measured from the date/time of sample collection.

°C = Degrees Celsius

mL = milliliter

CLP = Contract Laboratory Program

VOC = Volatile Organic Compound

TCL = Target Compound List

TAL = Target Analyte List

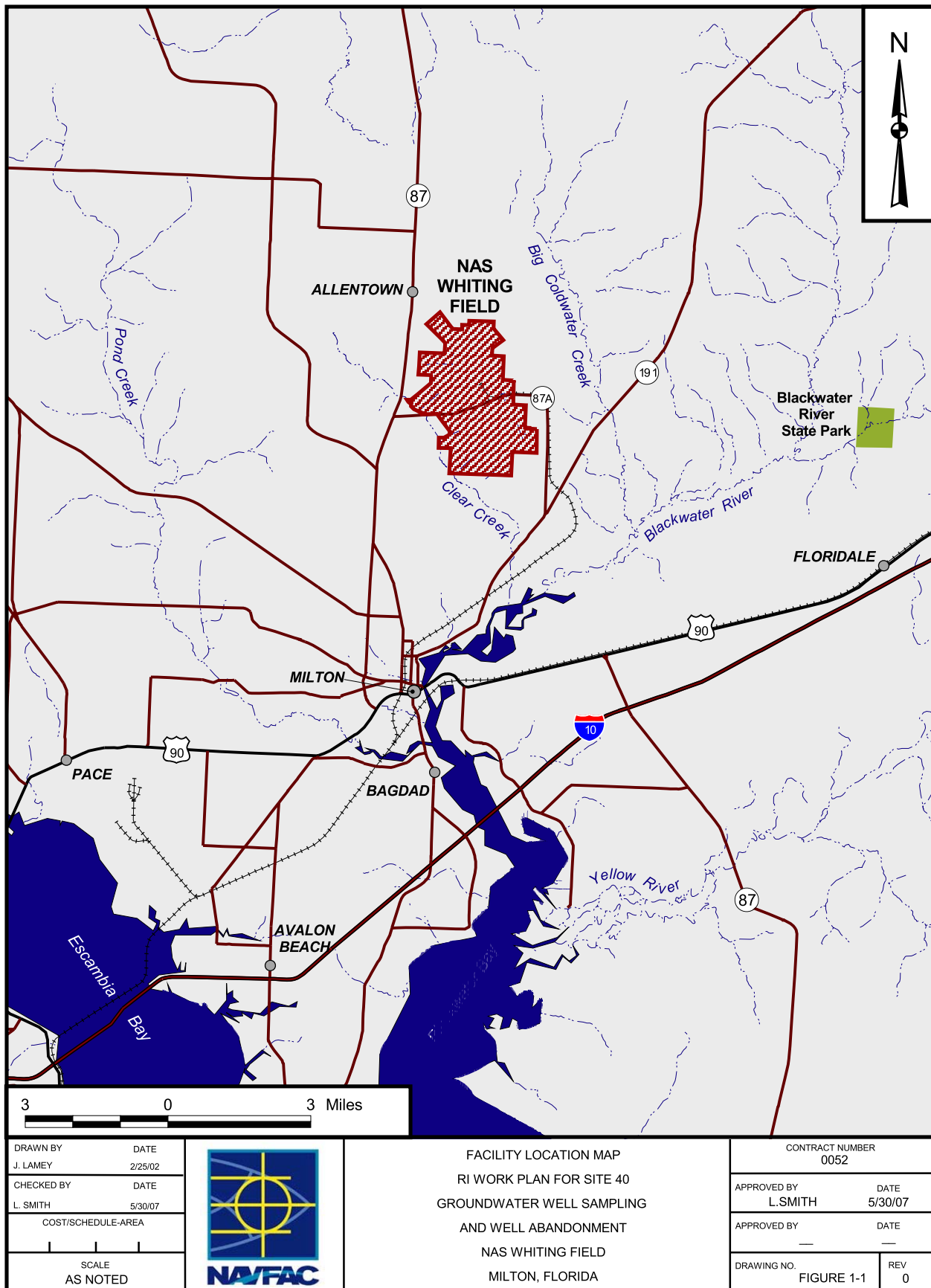
EDB = Ethylene dibromide

HCl = Hydrochloric Acid

HNO<sub>3</sub> = Nitric Acid

DNA = deoxyribonucleic acid

NA = Not Applicable

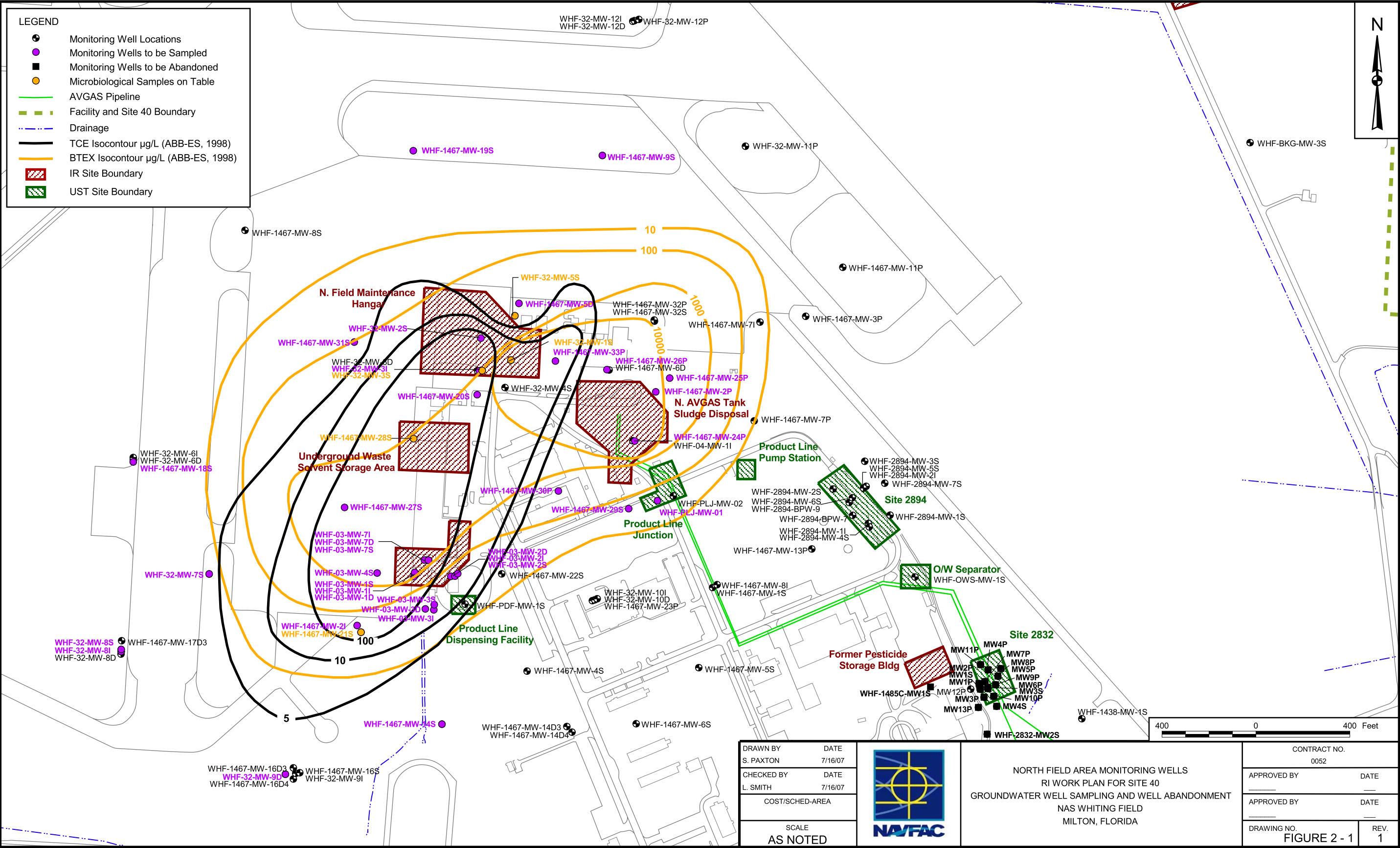


DRAWN BY J. LAMEY	DATE 2/25/02
CHECKED BY L. SMITH	DATE 5/30/07
COST/SCHEDULE-AREA	
SCALE AS NOTED	



FACILITY LOCATION MAP  
RI WORK PLAN FOR SITE 40  
GROUNDWATER WELL SAMPLING  
AND WELL ABANDONMENT  
NAS WHITING FIELD  
MILTON, FLORIDA

CONTRACT NUMBER 0052	
APPROVED BY L. SMITH	DATE 5/30/07
APPROVED BY	DATE
DRAWING NO. FIGURE 1-1	REV 0





## **APPENDIX A**

### **FIELD FORMS**



**TETRA TECH NUS**  
**FIELD TASK MODIFICATION REQUEST FORM**

Project/Installation Name \_\_\_\_\_ CTO & Project Number \_\_\_\_\_ Task Mod. Number \_\_\_\_\_

Modification To (e.g. Work Plan) \_\_\_\_\_ Site/Sample Location \_\_\_\_\_ Date \_\_\_\_\_

Activity Description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Reason for Change: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Recommended Disposition: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Field Operations Leader (Signature) \_\_\_\_\_ Date \_\_\_\_\_

Approved Disposition: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Project/Task Order Manager (Signature) \_\_\_\_\_ Date \_\_\_\_\_

Distribution:

Program/Project File – \_\_\_\_\_  
Project/Task Order Manager – \_\_\_\_\_  
Field Operations Leader – \_\_\_\_\_  
Other: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## GROUNDWATER LEVEL MEASUREMENT SHEET

<b>Project Name:</b>	<u>GW Abandonment NAS Whitin Field</u>	<b>Project No.:</b>	<u>112G00699</u>
<b>Location:</b>	<u>Site 40</u>	<b>Personnel:</b>	_____
<b>Weather Conditions:</b>	_____	<b>Measuring Device:</b>	_____
<b>Tidally Influenced:</b>	<b>Yes</b> ____ <b>No</b> ____	<b>Remarks:</b>	_____

[illegible]



Tetra Tech NUS, Inc.

## DAILY ACTIVITIES RECORD

**PROJECT NAME:** Site 40 GW Abandonment, NAS Whiting Field **PROJECT NUMBER:** 112G00699  
**CLIENT:** \_\_\_\_\_ **LOCATION:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_ **ARRIVAL TIME:** \_\_\_\_\_  
**Tt NUS PERSONNEL:** \_\_\_\_\_ **DEPARTURE TIME:** \_\_\_\_\_  
**CONTRACTOR:** \_\_\_\_\_ **DRILLER:** \_\_\_\_\_

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

**COMMENTS:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**APPROVED BY:** \_\_\_\_\_

\_\_\_\_\_  
Tt NUS REPRESENTATIVE

\_\_\_\_\_  
DRILLER

DATE: \_\_\_\_\_

# GROUNDWATER SAMPLING LOG

SITE NAME: Site 40		SITE LOCATION: NAS Whiting Field	
WELL NO:	SAMPLE ID:		DATE:

## PURGING DATA

[illegible]

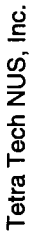
## SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:				SAMPLER(S) SIGNATURES:			SAMPLING INITIATED AT:		SAMPLING ENDED AT:	
PUMP OR TUBING DEPTH IN WELL (feet):				SAMPLE PUMP FLOW RATE (mL per minute):			TUBING MATERIAL CODE:			
FIELD DECONTAMINATION:    Y        N				FIELD-FILTERED:    Y        N        FILTER SIZE: _____ µm Filtration Equipment Type: _____			DUPLICATE:                    Y                    N			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH				
REMARKS:										
<b>MATERIAL CODES:</b> <b>AG</b> = Amber Glass; <b>CG</b> = Clear Glass; <b>PE</b> = Polyethylene; <b>PP</b> = Polypropylene; <b>S</b> = Silicone; <b>T</b> = Teflon; <b>O</b> = Other (Specify)										
<b>SAMPLING/PURGING EQUIPMENT CODES:</b> <b>APP</b> = After Peristaltic Pump; <b>B</b> = Bailer; <b>BP</b> = Bladder Pump; <b>ESP</b> = Electric Submersible Pump; <b>PP</b> = Peristaltic Pump <b>RFPP</b> = Reverse Flow Peristaltic Pump; <b>SM</b> = Straw Method (Tubing Gravity Drain); <b>VT</b> = Vacuum Trap; <b>O</b> = Other (Specify)										

**NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

**2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)**

**pH:**  $\pm 0.2$  units **Temperature:**  $\pm 0.2$  °C **Specific Conductance:**  $\pm 5\%$  **Dissolved Oxygen:** all readings  $\leq 20\%$  saturation (see Table FS 2200-2); optionally,  $\pm 0.2$  mg/L or  $\pm 10\%$  (whichever is greater) **Turbidity:** all readings  $\leq 20$  NTU; optionally  $\pm 5$  NTU or  $\pm 10\%$  (whichever is greater)



# EQUIPMENT CALIBRATION LOG

**PROJECT NAME: GW Abandonment NAS Whiting**

INSTRUMENT NAME/MODEL:

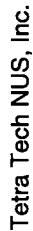
**SITE NAME:** Site 40

**MANUFACTURER:**

PROJECT No.: 112G00699

**SERIAL NUMBER:**

[illegible]



# EQUIPMENT CALIBRATION LOG

**PROJECT NAME: GW Abandonment NAS Whiting**

INSTRUMENT NAME/MODEL:

**SITE NAME:** Site 40

**MANUFACTURER:**

PROJECT No.: 112G00699

**SERIAL NUMBER:**

[illegible]

## **APPENDIX B**

### **STANDARD OPERATING PROCEDURE**

**FC 1000: Cleaning/Decontamination Procedures**

**FD 1000: Documentation Procedures**

**FS 1000: General Sampling Procedures**

**FS 2200: Groundwater Sampling**

## ***FC 1000. CLEANING / DECONTAMINATION PROCEDURES***

### **1. PERFORMANCE CRITERIA**

- 1.1. The cleaning/decontamination procedures must ensure that all equipment that contacts a sample during sample collection is free from the analytes of interest and constituents that would interfere with the analytes of interest.
- 1.2. The detergents and other cleaning supplies cannot contribute analytes of interest or interfering constituents unless these are effectively removed during a subsequent step in the cleaning procedure.
- 1.3. The result of any cleaning procedure (including all cleaning reagents) must be equipment blanks with reported non-detected values.

The cleaning procedures outlined in this SOP are designed to meet the above-mentioned performance criteria. Alternative cleaning reagents or procedures may be used. However, the organization must be prepared to demonstrate through documentation (i.e., company-written protocols and analytical records) and historical data (i.e., absence of analytes of interest in equipment blanks) that it consistently meets these performance criteria. Field quality control measures (see FQ 1210) must support the use of alternative reagents or procedures.

### **FC 1001. Cleaning Reagents**

Recommendations for the types and grades of various cleaning supplies are outlined below. The recommended reagent types or grades were selected to ensure that the cleaned equipment is free from any detectable contamination.

1. **DETERGENTS:** Use Liqui-Nox (or a non-phosphate equivalent) or Alconox (or equivalent). Liqui-Nox (or equivalent) is recommended by EPA, although Alconox (or equivalent) may be substituted if the sampling equipment will not be used to collect phosphorus or phosphorus-containing compounds.

### **2. SOLVENTS**

2.1. Use pesticide grade isopropanol as the rinse solvent in routine equipment cleaning procedures. This grade of alcohol must be purchased from a laboratory supply vendor. Rubbing alcohol or other commonly available sources of isopropanol **are not acceptable**.

2.2. Other solvents, such as acetone or methanol, may be used as the final rinse solvent if they are pesticide grade. However, methanol is more toxic to the environment and acetone may be an analyte of interest for volatile organics.

2.2.1. **Do not use** acetone if volatile organics are of interest.

2.3. Properly dispose of all wastes according to applicable regulations. Containerize all solvents (including rinsates) for on-site remediation or off-site disposal, as required.

2.4. Pre-clean equipment that is heavily contaminated (see FC 1120, section 3) with organic analytes with reagent grade acetone and hexane or other suitable solvents.

2.5. Use pesticide grade methylene chloride when cleaning sample containers.

2.6. Store all solvents away from potential sources of contamination (gas, copier supplies, etc.).

### 3. ANALYTE-FREE WATER SOURCES

- 3.1. Analyte-free water is water in which all analytes of interest and all interferences are below method detection limits.
- 3.2. Maintain documentation (such as results from equipment blanks) to demonstrate the reliability and purity of analyte-free water source(s).
- 3.3. The source of the water must meet the requirements of the analytical method and must be free from the analytes of interest. In general, the following water types are associated with specific analyte groups:
  - Milli-Q (or equivalent polished water): suitable for all analyses.
  - Organic-free: suitable for volatile and extractable organics.
  - Deionized water: may not be suitable for volatile and extractable organics.
  - Distilled water: not suitable for volatile and extractable organics, metals or ultra-trace metals.
- 3.4. Use analyte-free water for blank preparation and the final decontamination water rinse.
- 3.5. In order to minimize long-term storage and potential leaching problems, obtain or purchase analyte-free water just prior to the sampling event. If obtained from a source (such as a laboratory), fill the transport containers and use the contents for a single sampling event. Empty the transport container(s) at the end of the sampling event.
- 3.6. Discard any analyte-free water that is transferred to a dispensing container (such as a wash bottle) at the end of each sampling day.

### 4. ACIDS

- 4.1. Reagent Grade Nitric Acid: 10 - 15% (one volume concentrated nitric acid and five volumes deionized water).
  - 4.1.1. Use for the acid rinse unless nitrogen components (e.g., nitrate, nitrite, etc.) are to be sampled.
  - 4.1.2. If sampling for ultra-trace levels of metals, use an ultra-pure grade acid.
- 4.2. Reagent Grade Hydrochloric Acid: 10% hydrochloric acid (one volume concentrated hydrochloric and three volumes deionized water).
  - 4.2.1. Use when nitrogen components are to be sampled.
- 4.3. If samples for both metals and the nitrogen-containing components (see FC 1001, section 4.1.1 above) are collected with the equipment, use the hydrochloric acid rinse, or thoroughly rinse with hydrochloric acid after a nitric acid rinse.
- 4.4. If sampling for ultra trace levels of metals, use an ultra-pure grade acid.
- 4.5. Freshly prepared acid solutions may be recycled during the sampling event or cleaning process. Dispose appropriately at the end of the sampling event, cleaning process or if acid is discolored or appears otherwise contaminated (e.g., floating particulates).
  - 4.5.1. Transport only the quantity necessary to complete the sampling event.
- 4.6. Dispose of any unused acids according to FDEP and local ordinances.

## **FC 1002. Reagent Storage Containers**

The contents of all containers must be clearly marked.

1. DETERGENTS: Store in the original container or in a high density polyethylene (HDPE) or polypropylene (PP) container.
2. SOLVENTS
  - 2.1. Store solvents to be used for cleaning or decontamination in the original container until use in the field. If transferred to another container for field use, the container must be either glass or Teflon.
  - 2.2. Use dispensing containers constructed of glass, Teflon, or stainless steel. Note: if stainless steel sprayers are used, any gaskets that contact the solvents must be constructed of inert materials.
3. ANALYTE-FREE WATER: Transport in containers appropriate to the type of water to be stored. If the water is commercially purchased (e.g., grocery store), use the original containers when transporting the water to the field. Containers made of glass, Teflon, polypropylene, or HDPE are acceptable.
  - 3.1. Use glass or Teflon to transport organic-free sources of water on-site. Polypropylene or HDPE may be used but are not recommended.
  - 3.2. Dispense water from containers made of glass, Teflon, HDPE or polypropylene.
  - 3.3. Do not store water in transport containers for more than three days before beginning a sampling event.
  - 3.4. If working on a project that has oversight from EPA Region 4, use glass containers for the transport and storage of all water.
  - 3.5. Store and dispense acids using containers made of glass, Teflon or plastic.

## **FC 1003. General Requirements**

1. Before using any equipment, clean/decontaminate all sampling equipment (pumps, tubing, lanyards, split spoons, etc.) that are exposed to the sample.
  - 1.1. Before installing, clean (or obtain as certified precleaned) all equipment that is dedicated to a single sampling point and remains in contact with the sample medium (e.g., permanently installed groundwater pump (see FS 2220, section 3.3.4)).
  - 1.2. Clean this equipment any time it is removed for maintenance or repair.
  - 1.3. Replace dedicated tubing if discolored or damaged.
2. Clean all equipment in a designated area having a controlled environment (house, laboratory, or base of field operations) and transport to the field precleaned and ready to use, unless otherwise justified.
3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.
4. Whenever possible, transport sufficient clean equipment to the field so that an entire sampling event can be conducted without the need for cleaning equipment in the field.

5. Segregate equipment that is only used once (i.e., not cleaned in the field) from clean equipment and return to the in-house cleaning facility to be cleaned in a controlled environment.
6. Protect decontaminated field equipment from environmental contamination by securely wrapping and sealing with one of the following:
  - 6.1. Aluminum foil (commercial grade is acceptable);
  - 6.2. Untreated butcher paper; or
  - 6.3. Clean, untreated, disposable plastic bags. Plastic bags may be used:
    - 6.3.1. For all analyte groups except volatile and extractable organics;
    - 6.3.2. For volatile and extractable organics if the equipment is first wrapped in foil or butcher paper or if the equipment is completely dry.
7. Containerize all solvent rinsing wastes, detergent wastes and other chemical wastes requiring off-site or regulated disposal. Dispose of all wastes in conformance with applicable regulations.

## **FC 1100. Cleaning Sample Collection Equipment**

### **FC 1110. ON-SITE/IN-FIELD CLEANING**

1. Cleaning equipment on-site is not recommended because:
  - 1.1. Environmental conditions cannot be controlled.
  - 1.2. Wastes (solvents and acids) must be containerized for proper disposal.
2. If performed, follow the appropriate cleaning procedure as outlined in FC 1130. Ambient temperature water may be substituted in the hot, sudsy water bath, and hot water rinses.

<b>Note: Properly dispose of all solvents and acids.</b>
--

3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

### **FC 1120. HEAVILY CONTAMINATED EQUIPMENT**

In order to avoid contaminating other samples, isolate heavily contaminated equipment from other equipment and thoroughly decontaminate the equipment before further use. Equipment is considered heavily contaminated if it:

- Has been used to collect samples from a source known to contain significantly higher levels than background;
  - Has been used to collect free product; or
  - Has been used to collect industrial products (e.g., pesticides or solvents) or their by-products.
1. Cleaning heavily contaminated equipment in the field is not recommended.
  2. ON-SITE PROCEDURES

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- 2.1. Protect all other equipment, personnel and samples from exposure by isolating the equipment immediately after use.
  - 2.2. At a minimum, place the equipment in a tightly sealed untreated plastic bag.
  - 2.3. Do not store or ship the contaminated equipment next to clean, decontaminated equipment, unused sample containers, or filled sample containers.
  - 2.4. Transport the equipment back to the base of operations for thorough decontamination.
  - 2.5. If cleaning must occur in the field, and in order to document the effectiveness of the procedure, collect and analyze blanks on the cleaned equipment (see FQ 1000).
3. CLEANING PROCEDURES
- 3.1. If organic contamination cannot be readily removed with scrubbing and a detergent solution, prerinse equipment by thoroughly rinsing or soaking the equipment in acetone.
    - 3.1.1. Use hexane only if preceded and followed by acetone.
  - 3.2. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with routine cleaning procedures.
  - 3.3. After the solvent rinses (and/or steam cleaning), use the appropriate cleaning procedure (see FC 1130).
    - 3.3.1. Scrub, rather than soak all equipment with sudsy water.
    - 3.3.2. If high levels of metals are suspected and the equipment cannot be cleaned without acid rinsing, soak the equipment in the appropriate acid. Since stainless steel equipment should not be exposed to acid rinses, do not use stainless steel equipment when heavy metal contamination is suspected or present.
  - 3.4. If the field equipment cannot be cleaned utilizing these procedures, discard unless further cleaning with stronger solvents and/or oxidizing solutions is effective as evidenced by visual observation and blanks.
  - 3.5. Clearly mark or disable all discarded equipment to discourage use.

**FC 1130. GENERAL CLEANING**

Follow these procedures when cleaning equipment under controlled conditions. See FC 1110 for modifications if cleaning is performed on-site. Check manufacturer's instructions for cleaning restrictions and/or recommendations.

**FC 1131. Procedure for Teflon, Stainless Steel and Glass Sampling Equipment**

This procedure must be used when sampling for **ALL** analyte groups: extractable organics, metals, nutrients, etc. or if a single decontamination protocol is desired to clean all Teflon, stainless steel and glass equipment.

1. Rinse equipment with hot tap water.
2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).
3. If necessary, use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with hot tap water.

5. If samples for trace metals or inorganic analytes will be collected with the equipment and the equipment **is not** stainless steel, thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4).
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water.
7. If samples for volatile or extractable organics will be collected, rinse with isopropanol. Wet equipment surfaces thoroughly with free-flowing solvent. Rinse thoroughly with analyte-free water (see FC 1001, section 3).
8. Allow to air dry. Wrap and seal according to FC 1003, section 6 as soon as the equipment is air-dried.
9. If isopropanol is used, the equipment may be air-dried without the final analyte-free water rinse (see FC 1131, section 8 above); however, **the equipment must be completely dry before wrapping or use.**
10. Wrap clean sampling equipment according to the procedure described in FC 1003, section 6.

#### **FC 1132. General Cleaning Procedure for Plastic Sampling Equipment**

1. Rinse equipment with hot tap water.
2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).
3. If necessary, use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with hot tap water.
5. Thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4).
- 4). Check manufacturer's instructions for cleaning restrictions and/or recommendations.
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water. Allow to air dry as long as possible.
7. Wrap clean sampling equipment according to the procedure described in FC 1003, section 6.

#### **FC 1133. Cleaning Procedure by Analyte Group**

See Table FC 1000-1 for the procedures to be used to decontaminate equipment based on construction of sampling equipment, and analyte groups to be sampled.

#### **FC 1140. AUTOMATIC SAMPLERS, SAMPLING TRAINS AND BOTTLES**

1. When automatic samplers are deployed for extended time periods, clean the sampler using the following procedures when routine maintenance is performed. Inspect deployed samplers prior to each use. At a minimum, change the tubing if it has become discolored or has lost elasticity (FC 1140, section 2.3 below).
2. Clean all automatic samplers (such as ISCO) as follows:
  - 2.1. Wash the exterior and accessible interior portions of the automatic samplers (excluding the waterproof timing mechanisms) with laboratory detergent (see FC 1001, section 1) and rinse with tap water.

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- 2.2. Clean the face of the timing case mechanisms with a clean, damp cloth.
- 2.3. Check all tubing (sample intake and pump tubing). Change the tubing every six months (if used frequently) or if it has become discolored (i.e., affected by mold and algae) or if it has lost its elasticity.
- 2.4. See FC 1160, section 4 for the procedures associated with cleaning the tubing in the pump head.
3. AUTOMATIC SAMPLER ROTARY FUNNEL AND DISTRIBUTOR
  - 3.1. Clean with hot sudsy water and a brush (see FC 1001, section 1 for appropriate detergent type).
  - 3.2. Rinse thoroughly with analyte-free water.
  - 3.3. Air dry.
  - 3.4. Replace in sampler.
4. SAMPLER METAL TUBE: Clean as outlined in FC 1160, section 5.
5. REUSABLE GLASS COMPOSITE SAMPLE CONTAINERS
  - 5.1. If containers are used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the container several times with reagent-grade acetone before the detergent wash. If material cannot be removed with acetone, discard the container.
  - 5.2. Wash containers following the procedure outlined in FC 1131 above. End with a final solvent rinse if organics are to be sampled.
  - 5.3. Invert containers to drain and air dry for at least 24 hours.
  - 5.4. Cap with aluminum foil, Teflon film or the decontaminated Teflon-lined lid.
  - 5.5. After use, rinse with water in the field, seal with aluminum foil to keep the interior of the container wet, and return to the laboratory or base of operations.
  - 5.6. **Do not recycle or reuse containers if:**
    - 5.6.1. They were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;
    - 5.6.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or
    - 5.6.3. The containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers must be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.
    - 5.6.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest **before** use. If found to be contaminated, (i.e., constituents of interest are found at method detection levels or higher), then **discard the containers.**
6. REUSABLE PLASTIC COMPOSITE SAMPLE CONTAINERS
  - 6.1. Follow FC 1132.

- 6.2. Inspect the containers. Determine if the containers can be reused by the criteria in FC 1140, section 5 above.
7. GLASS SEQUENTIAL SAMPLE BOTTLES FOR AUTOMATIC SAMPLER BASED FOR SEQUENTIAL MODE
  - 7.1. Clean glass sequential sample bottles to be used for collecting inorganic samples by using a laboratory dishwasher (see FC 1140, sections 7.1.1 through 7.1.3 below) or manually following the procedures in FC 1131.
    - 7.1.1. Rinse with appropriate acid solution (see FC 1001, section 4).
    - 7.1.2. Rinse thoroughly with tap water.
    - 7.1.3. Wash in dishwasher at wash cycle, using laboratory detergent cycle, followed by tap and analyte-free water rinse cycles.
  - 7.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.
  - 7.3. Rinse bottles in the field with water as soon as possible after sampling event.
8. Glass Sequential Sample Bottles (Automatic Sampler based for Sequential Mode) to be used for Collecting Samples for Organic Compounds
  - 8.1. Use cleaning procedures outlined in FC 1131. Allow containers to thoroughly air dry before use.
  - 8.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.
9. BOTTLE SIPHONS USED TO TRANSFER SAMPLES FROM COMPOSITE CONTAINERS
  - 9.1. Rinse tubing with solvent and dry overnight in a drying oven.
  - 9.2. Cap ends with aluminum foil and/or Teflon film for storage.
  - 9.3. Seal in plastic for storage and transport.
  - 9.4. Flush siphon thoroughly with sample before use.
10. REUSABLE TEFLON COMPOSITE MIXER RODS
  - 10.1. Follow procedures outlined in FC 1131.
  - 10.2. Wrap in aluminum foil for storage.

## **FC 1150. FILTRATION EQUIPMENT**

1. DISSOLVED CONSTITUENTS USING IN-LINE, MOLDED AND DISPOSABLE FILTER UNITS
  - 1.1. Peristaltic Pump
    - 1.1.1. Clean the pump following procedures in FC 1170, section 2.2.
    - 1.1.2. Clean the pump head tubing following FC 1160, section 4.
    - 1.1.3. If Teflon tubing is used, clean following the procedures in FC 1160, section 3.
    - 1.1.4. Clean other tubing types such as polyethylene according to the appropriate procedures listed in FC 1160, section 7.
  - 1.2. Other Equipment Types (e.g., pressurized Teflon bailer)

1.2.1. Follow the appropriate cleaning regimen specified in FC 1131 through FC 1132 for other types of equipment that utilize in-line, molded and disposable filters.

**Note: Filtration units for dissolved metals must follow the configuration and requirements outlined in FS 2225.**

2. DISSOLVED CONSTITUENTS USING NON-DISPOSABLE FILTRATION UNITS (E.G., SYRINGES, "TRIPOD ASSEMBLY")

2.1. Stainless Steel or Glass Units

2.1.1. Follow FC 1131, assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.

2.1.2. Remove and clean any transfer tubing according to the appropriate cleaning procedures (see FC 1160).

2.1.3. Assemble the unit and cap both the pressure inlet and sample discharge lines (or whole unit if a syringe) with aluminum foil to prevent contamination during storage.

2.1.4. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.

2.2. Reusable In-Line Filter Holders

2.2.1. Clean, using FC 1131, (if Teflon, glass or stainless steel) or FC 1132 (if plastic) assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.

2.2.2. Assemble the unit and wrap with aluminum foil to prevent contamination during storage.

2.2.3. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.

3. FILTERS

3.1. Do not clean filters. Instructions for rinsing the filters prior to use are discussed in the applicable sampling SOPs (FS 2000 - FS 8000).

**FC 1160. SAMPLE TUBING DECONTAMINATION**

1. Check tubing:

1.1. For discoloration: Remove discolored tubing from use until it can be cleaned. If the discoloration cannot be removed, discard the tubing.

1.2. For elasticity (if used in a peristaltic-type pump): Discard any tubing that has lost its elasticity.

2. Transport all tubing to the field in precut, **precleaned** sections.

3. TEFLON, POLYETHYLENE AND POLYPROPYLENE TUBING

3.1. New Tubing: Follow this procedure unless the manufacturer/supplier provides certification that the tubing is clean.

3.1.1. Teflon

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- 3.1.1.1. Rinse outside of tubing with pesticide-grade solvent (see FC 1001, section 2).
- 3.1.1.2. Flush inside of tubing with pesticide-grade solvent.
- 3.1.1.3. Dry overnight in drying oven or equivalent (zero air, nitrogen, etc.).

3.1.2. Polyethylene and Polypropylene

- 3.1.2.1. Clean the exterior and interior of the tubing by soaking in hot, sudsy water.
- 3.1.2.2. Thoroughly rinse the exterior and interior of the tubing with tap water, followed by analyte-free water.

3.2. Reused Tubing

Use the following procedure for in-lab cleaning. **Field cleaning is not recommended:**

- 3.2.1. Clean the exterior of the tubing by soaking in hot, sudsy water (see FC 1001, section 1) in a stainless steel sink (or equivalent non-contaminating material). Use a brush to remove any particulates, if necessary.
- 3.2.2. Use a small bottle brush and clean the inside of the tubing ends where the barbs are to be inserted or cut 1-2 inches from the ends of the tubing after cleaning.
- 3.2.3. Rinse tubing exterior and ends liberally with tap water.
- 3.2.4. Rinse tubing surfaces and ends with the appropriate acid solution (see FC 1001, section 4), tap water, isopropanol (see FC 1001, section 2), and finally analyte-free water.
  - 3.2.4.1. Note: Eliminate the isopropanol rinse for polyethylene or polypropylene tubing.
- 3.2.5. Place tubing on fresh aluminum foil or clean polyethylene sheeting. Connect all of the precut lengths of tubing with Teflon inserts or barbs.
- 3.2.6. Cleaning configuration:
  - 3.2.6.1. Place cleaning reagents: [sudsy water (see FC 1001, section 1); acid (see FC 1001, section 4); isopropanol (see FC 1001, section 2)] in an appropriately cleaned container (2-liter glass jar is recommended).
  - 3.2.6.2. Place one end of the Teflon tubing into the cleaning solution.
  - 3.2.6.3. Attach the other end of the Teflon tubing set to the influent end of a pump.
  - 3.2.6.4. Recycle the effluent from the pump by connecting a length of Teflon tubing from the effluent to the glass jar with the cleaning reagents.
  - 3.2.6.5. Recycling as described above may be done for all reagents listed in FC 1160, section 3.2.6.1 above, **except** the final isopropanol rinse and the final analyte-free water rinse. Disconnect the tubing between the effluent end of the pump and the jar of cleaning reagents.
  - 3.2.6.6. Containerize isopropanol in a waste container for proper disposal.
  - 3.2.6.7. Analyte-free water may be discarded down the drain.
- 3.2.7. Using the above configuration described in FS 1160, section 3.2.6 above:

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3.2.7.1. Pump hot, sudsy water through the connected lengths. Allow the pump to run long enough to pump at least three complete tubing volumes through the tubing set.

3.2.7.2. Using the same procedure, successively pump tap water, the acid solution(s), tap water, isopropanol, and finally analyte-free water through the system.

3.2.7.3. Leave the Teflon inserts or barbs between the precut lengths and cap or connect the remaining ends.

3.2.8. After the interior has been cleaned as described in FC 1160, section 3.2.7 above, rinse the exterior of the tubing with analyte-free water.

3.2.9. Wrap the connected lengths in aluminum foil or untreated butcher paper and store in a clean, dry area until use.

#### 4. FLEXIBLE TUBING USED IN PUMP HEADS OF AUTOMATIC SAMPLERS AND OTHER PERISTALTIC PUMPS

Replace tubing after each sampling point if samples are collected through the tubing. Unless the pump is deployed to collect samples from the same location over a long period of time, remove and wash the tubing after each sampling event (see FC 1140, section 1).

4.1. Flush tubing with hot tap water then sudsy water (see FC 1001, section 1).

4.2. Rinse thoroughly with hot tap water.

4.3. Rinse thoroughly with analyte-free water.

4.4. If used to collect metals samples, flush the tubing with an appropriate acid solution (see FC 1001, section 4), followed by thorough rinsing with analyte-free water. If used to collect both metals and nitrogen components use hydrochloric acid (see FC 1001, section 4.1.1).

4.5. Install tubing in peristaltic pump or automatic sampler.

4.6. Cap both ends with aluminum foil or equivalent.

**Note: Change tubing at specified frequencies as part of routine preventative maintenance.**

#### 5. STAINLESS STEEL TUBING

Clean the exterior and interior of stainless steel tubing as follows:

5.1. Using sudsy water (see FC 1001, section 1), scrub the interior and exterior surfaces.

5.2. Rinse with hot tap water.

5.3. Rinse with analyte-free water.

5.4. If volatile or extractable organics are to be sampled, rinse all surfaces with isopropanol (see FC 1001, section 2). Use enough solvent to wet all surfaces with free flowing solvent.

5.5. Allow to air dry or thoroughly rinse with analyte-free water.

#### 6. GLASS TUBING

6.1. Use new glass tubing.

6.2. If volatile or extractable organics are to be sampled, rinse with isopropanol (see FC 1001, section 2).

- 6.3. Air dry for at least 24 hours.
- 6.4. Wrap in aluminum foil or untreated butcher paper to prevent contamination during storage.
- 6.5. Discard tubing after use.
7. MISCELLANEOUS NON-INERT TUBING TYPES (TYGON, RUBBER, PVC, ETC.)
  - 7.1. New Tubing
    - 7.1.1. As a general rule, new tubing may be used without preliminary cleaning.
    - 7.1.2. Protect new tubing from potential environmental contamination by wrapping in aluminum foil and sealing in untreated plastic bags or keep in the original sealed packaging until use.
    - 7.1.3. If new tubing is exposed to potential contamination, rinse the exterior and interior tubing surfaces with hot tap water followed by a thorough rinse with analyte-free water.
    - 7.1.4. If new tubing is to be used to collect samples, thoroughly rinse the tubing with sample water (i.e., pump sample water through the tubing) before collecting samples.
  - 7.2. Reused Tubing
    - 7.2.1. Flush tubing with sudsy solution of hot tap water and laboratory detergent (see FC 1001, section 1).
    - 7.2.2. Rinse exterior and interior thoroughly with hot tap water.
    - 7.2.3. Rinse exterior and interior thoroughly with analyte-free water.
    - 7.2.4. If used to collect only metals samples, flush the tubing with nitric acid (see FC 1001, section 4.1), followed by a thorough rinse with analyte-free water.
    - 7.2.5. If used to collect metals and nitrogen-containing compounds, see FC 1001, section 4.3.
    - 7.2.6. Cap ends in aluminum foil and store in clean, untreated plastic bags to prevent contamination during storage and transport.

## **FC 1170. PUMPS**

### **1. SUBMERSIBLE PUMPS**

- 1.1. Pumps used for Purging and Sampling Metals and/or Volatile and Extractable Organics
  - 1.1.1. Construction of pump body and internal mechanisms (bladders, impellers, etc.), including seals and connections, must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.
  - 1.1.2. Tubing material must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.
  - 1.1.3. Clean pump exterior following FC 1131. Note: omit the solvent rinse if the pump body is constructed of plastic (e.g., ABS, PVC, etc.).
  - 1.1.4. Clean the pump internal cavity and mechanism as follows:
    - 1.1.4.1. If used only for purging, thoroughly flush the pump with water before purging the next well.

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1.1.4.2. If used for purging and sampling, completely disassemble the pump (if practical) and decontaminate between each well.

1.1.4.3. When used for purging and sampling and the pump cannot be (practicably) disassembled, then clean the internal cavity/mechanism by pumping several gallons of sudsy water (see FC 1001, section 1), followed by several gallons of tap water, and finally, several gallons of analyte-free water.

1.1.4.4. If multiple sampling points are located in an area that is not accessible by a vehicle, and it is difficult to return to the vehicle for cleaning or to transport all cleaning materials to the staging location, at a minimum thoroughly rinse the pump with water.

1.1.5. Refer to FC 1160, section 3 to clean Teflon tubing.

1.1.6. Refer to FC 1160, section 5 for stainless steel tubing.

1.1.7. Clean other types of tubing according to FC 1160, sections 6 and 7.

**1.2. Pumps used for Purging and Sampling all Analytes except Metals and Volatile and Extractable Organics**

1.2.1. Pump construction: no restrictions.

1.2.2. Pump tubing material: no restrictions.

1.2.3. Scrub the exterior of the pump with appropriate metal-free, phosphate-free or ammonia-free detergent solution.

1.2.4. Rinse the exterior with tap water and analyte-free water.

1.2.5. Rinse the interior of the pump and tubing by pumping tap or analyte-free water through the system using a clean bucket or drum.

**2. ABOVE-GROUND PUMPS USED FOR PURGING AND SAMPLING**

**2.1. Pumps used only for Purging**

2.1.1. The exterior of the pump must be free of oil and grease.

2.1.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.

2.1.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

**2.2. Pumps used for Sampling**

2.2.1. Clean the exterior of the pump with a detergent solution followed by a tap water rinse. Use clean cloths or unbleached paper towels that have been moistened with the appropriate solution to wipe down the pump.

2.2.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.

2.2.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

**FC 1180. ANALYTE-FREE WATER CONTAINERS**

This section pertains to containers that are purchased to transport, store and dispense analyte-free water. It does not apply to water that has been purchased in containers. See FC 1002, section 3 for appropriate construction materials.

1. NEW CONTAINERS

- 1.1. Wash containers and caps according to FC 1131, omitting the solvent rinse if plastic (polyethylene or polypropylene) containers are being cleaned.
- 1.2. Cap with Teflon film or the bottle cap. The bottle cap must be composed of the same material as the container and cannot be lined.

2. REUSED CONTAINERS

- 2.1. Immediately after emptying, cap with aluminum foil (if not being used for metals), Teflon film or the container cap.
- 2.2. Wash the exterior of the container with lab-grade detergent solution (see FC 1001, section 1) and rinse with analyte-free water.
- 2.3. Rinse the interior thoroughly with analyte-free water.
- 2.4. Invert and allow to drain and dry.

**FC 1190. ICE CHESTS AND SHIPPING CONTAINERS**

1. Wash the exterior and interior of all ice chests with laboratory detergent (see FC 1001, section 1) after each use.
2. Rinse with tap water and air dry before storing.
3. If the ice chest becomes severely contaminated with concentrated waste or other toxic or hazardous materials clean as thoroughly as possible, render unusable, and properly dispose.

**FC 1200. Field Instruments and Drilling Equipment**

**FC 1210. FIELD INSTRUMENTS (TAPES, METERS, ETC.)**

Follow manufacturer's recommendations for cleaning instruments. At a minimum:

1. Wipe down equipment body, probes, and cables with lab-grade detergent solution (see FC 1001, section 1). Check manufacturer's instructions for recommendations and/or restrictions on cleaning.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with analyte-free water.
4. Store equipment according to the manufacturer's recommendation or wrap equipment in aluminum foil, untreated butcher paper or untreated plastic bags to eliminate potential environmental contamination.

**FC 1220. SOIL BORING EQUIPMENT**

This section pertains only to equipment that is not used to collect samples. Clean split spoons, bucket augers and other sampling devices according to FC 1131.

1. Remove oil, grease, and hydraulic fluid from the exterior of the engine and power head, auger stems, bits and other associated equipment with a power washer or steam jenny or wash by hand with a brush and sudsy waster (no degreasers).
2. Rinse thoroughly with tap water.

### **FC 1230. WELL CASING CLEANING**

These are recommended procedures for cleaning well casing and riser pipes. Use procedures specified by a FDEP contract, order, permit, or rule, if different or more stringent than the procedures outlined below.

1. FDEP recommends only using casing that is designed for subsurface environmental groundwater monitoring.
2. Casing that has been contaminated with grease, hydraulic fluid, petroleum fuel, etc. may require additional cleaning or deemed unusable.
3. Clean all casing and riser pipe should be cleaned before installation, unless the casing is received wrapped and ready for installation:
  - 3.1. Steam clean all casing and riser pipe. Steam cleaning criteria shall meet the following: water pressure - 2500 psi; water temperature - 200°F.
  - 3.2. Rinse thoroughly with tap (potable) water. This tap water must be free of the analytes of interest.

### **FC 1300. Sample Containers**

#### **FC 1310. OBTAINING CLEAN CONTAINERS**

1. Obtain clean sample containers in one of three ways:
  - 1.1. From commercial vendors as precleaned containers. The cleaning grades must meet EPA analyte specific requirements. Keep all records for these containers (lot numbers, certification statements, date of receipt, etc.) and document the container's intended uses;
  - 1.2. From internal groups within the organization that are responsible for cleaning and maintaining containers according to the procedures outlined in FC 1320; or
  - 1.3. From a subcontracted laboratory that is accredited under the National Environmental Laboratory Accreditation Program (NELAP).
    - 1.3.1. The contractor must verify that the laboratory follows the container cleaning procedures outlined in FC 1320.
    - 1.3.2. If the laboratory cleaning procedures are different, the contractor must require that the laboratory use the following cleaning procedures or provide documentation and historical records to show that their in-house procedure produces containers that are free from the analytes of interest.

#### **FC 1320. CONTAINER CLEANING PROCEDURES**

1. Refer to Table FC 1000-2. Follow the cleaning steps in the order specified in the chart.
2. Cleaning procedures that are different from those outlined in FC 1320 may be used as long as blanks collected in the containers are free from the analytes of interest and any analytical interferences and the cleaning procedures are supported by historical and continuing documentation.
3. Inspect all containers before cleaning.

**3.1. Do not recycle or reuse containers if:**

- 3.1.1. Containers were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;
- 3.1.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or
- 3.1.3. Containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers shall be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.
- 3.1.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest before use. If found to be contaminated (i.e., analytes of interest are found at MDL levels or higher), discard the containers.

**FC 1400. Documentation**

Document cleaning procedures described below for the indicated activities. See FD 1000 for additional information about required records and retention of documents.

**FC 1410. FIELD EQUIPMENT**

**1. IN-FIELD CLEANING**

- 1.1. Initially identify the procedures that are used to clean equipment in the field by SOP numbers and dates of usage.
- 1.2. Record the date and time that equipment was cleaned.

**2. IN-HOUSE CLEANING**

- 2.1. Retain any cleaning certificates, whether from a laboratory or commercial vendor.
- 2.2. Identify the procedure(s) that are used to clean equipment by the SOP number and dates of usage.
- 2.3. Record the date that the equipment was cleaned.

**FC 1420. SAMPLE CONTAINERS**

- 1. Organizations that order precleaned containers must retain the packing slips, and lot numbers of each shipment, any certification statements provided by the vendor and the vendor cleaning procedures.
- 2. Organizations that clean containers must maintain permanent records of the following:
  - 2.1. Procedure(s) used to clean containers by SOP number and dates of usage.
  - 2.2. If containers are certified clean by the laboratory the laboratory must record:
    - Type of container;
    - Date cleaned;
    - SOP used;
    - Person responsible for cleaning;

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- Lot number (date of cleaning may be used) of the batch of containers that were cleaned using the same reagent lots and the same procedure;
- The results of quality control tests that were run on lot numbers; and
- Any additional cleaning or problems that were encountered with a specific lot.

**FC 1430. REAGENTS AND OTHER CLEANING SUPPLIES**

Maintain a record of the lot number with the inclusive dates of use for all acids, solvents, and other cleaning supplies.

***FC 2000. REFERENCES***

1. Florida Department of Environmental Protection, DEP Standard Operating Procedures for Laboratory Operations and Sample Collection Activities, DEP QA-001/92, September 1992.
2. U.S. Environmental Protection Agency, Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.

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**Appendix FC 1000**  
**Tables, Figures and Forms**

Table FC 1000-1 Procedures for Decontamination at the Base of Operations or On-site

Table FC 1000-2 Container Cleaning Procedures

**Table FC 1000-1**  
**Procedures for Decontamination at the Base of Operations or On-Site**

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
Teflon or Glass	All	FC 1131	Follow as written	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Extractable & Volatile Organics		May omit acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Petroleum Hydrocarbons		May omit solvent rinse	May omit acid rinse
	Metals <sup>1</sup>			May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Radionuclides			May omit solvent rinse
	For ultra trace metals, refer to FS 8200			
Metallic (stainless steel, brass, etc.)	Inorganic Nonmetallics	FC 1131	May omit solvent rinse	Rinse several times with water
	Physical & Aggregate Properties			Rinse several times with sample water from the next sampling location
	Aggregate Organics			
	Biologicals			
	Volatile Inorganics			
	Microbiological – Viruses			
Metallic (stainless steel, brass, etc.)	Microbiological - Bacteria	FC 1131	Omit solvent and acid rinses	Rinse several times with water
	All			Rinse several times with sample water from the next sampling location
	Extractable & Volatile Organics		Omit the acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Petroleum Hydrocarbons			Omit the acid rinse
	Metals		Omit the acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Radionuclides		May omit the solvent rinse	Omit the acid rinse
	Inorganic Nonmetallics		May omit the solvent rinse	May omit the solvent rinse
	Physical & Aggregate Properties			Rinse several times with water
	Aggregate Organics		May omit the acid rinse	Rinse several times with sample water from the next sampling location
	Biologicals			
	Volatile Inorganics			

**Table FC 1000-1**  
**Procedures for Decontamination at the Base of Operations or On-Site**

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
Plastic	Microbiological – Viruses Microbiological - Bacteria		Omit solvent and acid rinses	Rinse several times with water Rinse several times with sample water from the next sampling location
	Polyethylene and polypropylene may be used to sample Volatile and Extractable Organics; Petroleum Hydrocarbons may not use plastic	FC 1132	Follow as written	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics		May omit the acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location
	Microbiological – Viruses Microbiological - Bacteria		Omit acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location

<sup>1</sup> Do not use glass if collecting samples for boron or silica.

**Table FC 1000-2**  
**Container Cleaning Procedures**

<b>ANALYSIS / ANALYTE GROUP</b>	<b>CLEANING STEPS See Description Below</b>
Extractable Organics	1, 2, 4, 6, (5 and 7 optional), 11
Volatile Organics	1, 2, 4, (6 optional, methanol only), 7
Metals	1, 2, 3, 4, 8, 11 ** **Procedures to clean containers for ultra-trace metals are found in FS 8200
Inorganic Nonmetallics, Radionuclides, Physical and Aggregate Properties, Aggregate Inorganics, and Volatile Inorganics	1, 2, 3*, 4, 8, 11 * For nutrients, replace nitric acid with hydrochloric acid, or use a hydrochloric acid rinse after the nitric acid rinse. See FC 1001, section 4
Petroleum Hydrocarbons, and Oil and Grease	1, 2, 3, 4, (5, 6, 7 optional), 11
Microbiological (all)	1, 2, 4, 8, 9, 11
Toxicity Tests (Includes Bioassays)	1, 2, 10, 2, 4, 6.1, (10 optional), 11

**NOTE:** Steps 1 and 2 may be omitted when cleaning new, uncertified containers.

1. Wash with hot tap water and a brush using a suitable laboratory-grade detergent:
  - 1.1. Volatile and Extractable Organics, Petroleum Hydrocarbon, Oil and Grease: Liqui-Nox, Alconox or equivalent;
  - 1.2. Inorganic nonmetallics: Liqui-Nox or equivalent;
  - 1.3. Metals: Liqui-Nox, Acationox, Micro or equivalents;
  - 1.4. Microbiologicals (all): Must pass an inhibitory residue test.
2. Rinse thoroughly with hot tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse thoroughly with analyte-free water (deionized or better).
5. Rinse thoroughly with pesticide-grade methylene chloride.
6. Rinse thoroughly with pesticide-grade isopropanol, acetone or methanol.
  - 6.1. For bioassays, use only acetone, and only when containers are glass.
7. Oven dry at 103°C to 125°C for at least 1 hour.
  - 7.1. VOC vials and containers must remain in the oven in a contaminant-free environment until needed. They should be capped in a contaminant-free environment just prior to dispatch to the field.

**Table FC 1000-2**  
**Container Cleaning Procedures**

8. Invert and air-dry in a contaminant-free environment.
9. Sterilize containers:
  - 9.1. Plastic: 60 min at 170°C, loosen caps to prevent distortion.
  - 9.2. Glass: 15 min at 121°C.
10. Rinse with 10% hydrochloric acid followed by a sodium bicarbonate solution.
11. Cap tightly and store in a contaminant-free environment until use. Do not use glass if collecting samples for boron or silica.

## ***FD 1000. DOCUMENTATION PROCEDURES***

### **1. INTRODUCTION:**

1.1. For the creation of unequivocal, accurate and methodical records to document all field activities affecting sample data, implement the following standard operating procedures for sample collection, sample handling and field-testing activities.

### **2. SCOPE AND APPLICABILITY**

2.1. This SOP provides a detailed listing of the information required for documentation of all sampling procedures and field testing.

2.2. Refer to the associated sampling or field testing SOP for any requirements for the chronological or sequential documentation of data.

### **3. QUALITY ASSURANCE**

3.1. : Implement review procedures to monitor and verify accurate manual and automated data entry and recordkeeping for all documentation tasks outlined in this SOP.

## **FD 1100. Universal Documentation Requirements**

Incorporate efficient archival design and succinct documentation schemes for all record systems. Ensure that the history of a sample is clearly evident in the retained records and documentation and can be independently reconstructed.

### **1. Criteria for All Documents**

1.1. Keep all applicable documentation available for inspection. Keep all original data and records as well as reduced or manipulated forms of the original data or records.

1.1.1. Authorized representatives of FDEP may legally inspect and request copies of any records using paper, electronic media or other media during any FDEP audit of physical facilities or on-site sampling events, and for any data validations conducted for applicable project data submitted to FDEP.

1.2. Record enough information so that clarifications, interpretations or explanations of the data are not required from the originator of the documentation.

1.3. Clearly indicate the nature and intent of all documentation and all record entries.

1.4. Link citations to SOPs and other documents by the complete name, reference or publication number, revision number and revision date for the cited document, when applicable. Also assign this information to internally generated SOPs.

1.5. Retain copies of all revisions of all cited documents as part of the documentation archives.

### **2. Procedures**

2.1. Sign, initial or encode all documentation entries made to paper, electronic or other records with a link indicating the name and responsibility of the author making the data entry, clearly indicating the reason for the signature, initials or code (e.g., "sampled by"; "released by"; "prepared by"; "reviewed by").

2.2. In order to abbreviate record entries, make references to procedures written in internal SOPs or methodology and procedures promulgated by external sources.

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2.2.1. Document the intent to use SOPs other than the FDEP SOPs, or to use allowable modifications to the FDEP SOPs by recording the effective date of use for all such SOPs or modifications.

2.2.1.1. Retain any correspondence with FDEP regarding approval to use alternative procedures for any projects.

2.2.2. Authorize all internal SOPs with the signatures of the quality assurance officer(s) and manager(s) responsible for implementation of the SOPs. Record the dates of signature.

2.3. Employ straightforward archiving of records to facilitate documentation tracking and retrieval of all current and archived records for purposes of inspection, verification and historical reconstruction of all procedures and measurement data.

2.4. Keep copies or originals of all documentation, including documentation sent to or received from external parties.

2.5. Use waterproof ink for all paper documentation.

2.6. Do not erase or obliterate entry errors on paper records. Make corrections by marking a line through the error so that it is still legible. Initial or sign the marked error and its correction.

2.7. Maintain electronic audit trails for all edited electronic records, if possible. Utilize software that allows tracking of users and data edits, if available. Software that prompts the user to double-check edits before execution is also preferred. See FD 1200.

2.8. Unequivocally link all documentation associated with a sample or measurement. Make cross-references to specific documentation when necessary.

2.9. Link final reports, data summaries or other condensed versions of data to the original sample data, including those prepared by external parties.

3. Retention Requirements

3.1. Per the FDEP QA Rule, 62-160.220 & .340, F.A.C., keep all documentation archives for a minimum of 5 years after the date of project completion or permit cycle unless otherwise specified in a Department contract, order, permit or Title 62 rules.

## **FD 1200. Electronic Documentation**

Handle electronic (digital) data as with any data according to applicable provisions of FD 1100.

1. Retention of Automatic Data Recording Products

1.1. For data not directly read from the instrument display and manually recorded, retain all products or outputs from automatic data recording devices, such as strip chart recorders, integrators, data loggers, field measurement devices, computers, etc. Store records in electronic, magnetic, optical or paper form, as necessary.

1.1.1. Retain all original, raw output data. Ensure archiving of these data prior to subsequent reduction or other manipulation of the data.

1.2. Identify output records as to purpose, analysis date and time, field sample identification number, etc. Maintain unequivocal linkage with the associated sample, other data source or measured medium and specific instrument used to make the measurement.

2. Electronic Data Security

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- 2.1. Control levels of access to electronic data systems as required to maintain system security and to prevent unauthorized editing of data.
- 2.2. Do not alter raw instrumentation data or original manual data records in any fashion without retention of the original raw data.
- 2.3. Maintain secure computer networks and appropriate virus protection as warranted for each system design.
3. Electronic Data Storage and Documentation
  - 3.1. Store all electronic, magnetic and optical media for easy retrieval of records.
    - 3.1.1. Ensure that all records can be printed to paper if needed for audit or verification purposes.
    - 3.1.2. If it is anticipated that the documentation archive will become unreadable due to obsolescence of a particular storage technology, retain a paper archive of the data or transfer to other suitable media.
  - 3.2. For easy retrieval of records, link all stored data to the associated sample data or other data source.
  - 3.3. Back up all data at a copy rate commensurate with the level of vulnerability of the data. Consider replicating all original data as soon as possible after origination.
4. Software Verification
  - 4.1. Ensure that any software used to perform automatic calculations conforms to required formulas or protocols.
  - 4.2. Document all software problems and their resolution in detail, where these problems have irretrievably affected data records or linkage. Record the calendar date, time, responsible personnel and relevant technical details of all affected data and software files. Note all software changes, updates, installations, etc. per the above concerns. File and link all associated service records supplied by vendors or other service personnel.
5. Protection of Equipment and Storage Media
  - 5.1. Place stationary computers, instrumentation and peripheral devices in locations of controlled temperature and humidity and away from areas where the potential for fluid leaks, fire, falling objects or other hazards may exist. In the field, protect portable equipment from weather, excess heat or freezing, storage in closed vehicles, spillage from reagents and samples, etc.
  - 5.2. Protect storage media from deteriorating conditions such as temperature, humidity, magnetic fields or other environmental hazards as above.

## **FD 1300. Documentation Using Other Media**

1. Universal Requirements
  - 1.1. Handle documentation prepared using other media according to FD 1100.
2. Protection of Stored Media
  - 2.1. Store media such as photographs, photographic negatives, microfilm, videotape, etc. under conditions generally prescribed for these media by manufacturers and conducive to long-term storage and protection from deterioration. See also FD 1200, section 5, above.

## ***FD 2000. DOCUMENTATION OF CLEANED EQUIPMENT, SAMPLE CONTAINERS, REAGENTS AND SUPPLIES***

When providing sample containers, preservation reagents, analyte-free water or sampling equipment, document certain aspects of these preparations.

### **1. Equipment Cleaning Documentation**

1.1. Document all cleaning procedures by stepwise description in an internal SOP if cleaning procedures in the FDEP SOP have been modified for use. Alternatively, cite the DEP SOP procedures in the cleaning record for the applicable equipment.

1.2. Record the date of cleaning.

1.2.1. If items are cleaned in the field during sampling activities for a site, document the date and time when the affected equipment was cleaned. Link this information with the site and the cleaning location at the site.

1.3. Retain or make accessible any certificates of cleanliness issued by vendors supplying cleaned equipment or sample containers.

1.3.1. Retain from the vendor or document for internal cleaning the following information for sample containers, as applicable:

- Packing slip and cleanliness certificates from vendors
- Container types and intended uses
- Lot numbers or other designations for groups of containers cleaned together using the same reagents and procedures
- Dates of cleaning
- Cleaning procedures or reference to internal cleaning SOPs or DEP SOPs
- Cleaning personnel names
- Results of quality control analyses associated with container lots
- Comments about problems or other information associated with container lots

### **2. Sampling Kit Documentation**

If supplied to a party other than internal staff, transmit to the recipient the following information pertaining to sampling equipment or other implements, sample containers, reagent containers, analyte-free water containers, reagents or analyte-free water supplied to the recipient.

- Quantity, description and material composition of all containers, container caps or closures or liners for caps or closures
- Intended application for each sample container type indicated by approved analytical method or analyte group(s)
- Type, lot number, amount and concentration of preservative added to clean sample containers and/or shipped as additional preservative
- Intended use for any additional preservatives or reagents provided
- Description of any analyte-free water (i.e., deionized, organic-free, etc.)

- Date of analyte-free water containerization
  - Date of sampling kit preparation
  - Description and material composition of all reagent transfer implements (e.g., pipets) shipped in the sampling kit and the analyte groups for which the implements have been cleaned or supplied
  - Quantity, description and material composition of all sampling equipment and pump tubing (including equipment supplied for filtration) and the analyte groups for which the equipment has been cleaned or supplied
  - Tare weight of VOC vials, as applicable (this item may be necessary in cases where EPA 5035 VOC sample vials are provided for soil samples)
3. Documentation for Reagents and other Chemicals
- 3.1. Keep a record of the lot numbers and inclusive dates of use for all reagents, detergents, solvents and other chemicals used for cleaning and sample preservation.
- 3.1.1. See FD 4000 below for documentation requirements for reagents used for field testing.

### ***FD 3000. DOCUMENTATION OF EQUIPMENT MAINTENANCE***

4. Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures, corrective actions performed during calibrations or verifications, and solution or parts replacement for instrument probes.
- 4.1. Include the calendar date for the procedures performed.
- 4.2. Record names of personnel performing the maintenance or repair tasks.
- 4.2.1. Describe any malfunctions necessitating repair or service.
- 4.3. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit employed. This may include a manufacturer name, model number, serial number, inventory number, etc.
5. Retain vendor service records for all affected instruments.
6. Record the following for rented equipment:
- Rental date(s)
  - Equipment type and model or inventory number or other description
7. Retain the manufacturer's operating and maintenance instructions.

### ***FD 4000. DOCUMENTATION FOR CALIBRATION OF FIELD-TESTING INSTRUMENTS AND FIELD ANALYSES***

Document acceptable instrument or measuring system calibration for each field test or analysis of a sample or other measurement medium.

## **FD 4100. General Documentation for all Field Testing**

1. STANDARD AND REAGENT DOCUMENTATION: Document information about standards and reagents used for calibrations, verifications and sample measurements.

1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

1.1.1. Document acceptable verification of any standard used after its expiration date.

1.2. Record the concentration or other value for the standard in the appropriate measurement units.

1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

1.2.2.1. Record the grade of standard or reagent used.

1.3. When formulated in-house, document all calculations used to formulate calibration standards.

1.3.1. Record the date of preparation for all in-house formulations.

1.4. Describe or cite the procedure(s) used to prepare any standards in-house (FDEP SOP or internal SOP).

2. FIELD INSTRUMENT CALIBRATION DOCUMENTATION: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

2.1. Retain vendor certifications of all factory-calibrated instrumentation.

2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

2.2.1. Record manufacturer name, model number and identifying number such as a serial number for each instrument unit.

2.3. Record the time and date of all initial calibrations and all calibration verifications.

2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

2.5. Record the name of the analyst(s) performing the calibration or verification.

2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., pH buffer)
- Value of standard, including correct units (e.g., pH = 7.0 SU)
- Link to information recorded according to section 1 above

2.7. Retain manufacturers' instrument specifications.

2.8. Document whether successful initial calibration occurred.

2.9. Document whether each calibration verification passed or failed.

2.10. Document, according to records requirements of FD 3000, any corrective actions taken to modify instrument performance.

2.10.1. Document date and time of any corrective actions.

2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

2.11. Describe or cite the specific calibration or verification procedure performed (FDEP SOP or internal SOP).

3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units for the measurement
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit used for the test (see 2.2 above)

## ***FD 5000. DOCUMENTATION OF SAMPLE COLLECTION, PRESERVATION AND TRANSPORT***

Follow these procedures for all samples. See FD 5100 - FD 5427 below for additional documentation for specific sampling activities. See example Forms in FD 9000 below for example formats for documenting specific sampling and testing procedures.

### **1. SAMPLE IDENTIFICATION REQUIREMENTS**

1.1. Label or tag each sample container with a unique field identification code that adequately distinguishes each sample according to the following criteria. The code must adequately link the sample container with all of the information about the sample contained in the permanent field record.

1.1.1. Link the unique field identification code to the sample source or sampling point identification, the date of sample collection, the time of sample collection (for maximum holding times equal to or less than 48 hours), the analytes of interest and the preservation technique.

1.1.2. Quality control samples, such as duplicate samples, other replicate samples and split samples, collected from the same sample source or sampling point on the same date and at the same time, must be identified and labeled or tagged with different field identification codes according to the requirements in 1.1.1 above, if the identical sample collection procedures are used for the QC samples and the QC samples are collected for the same analyte or group of analytes.

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1.1.3. Samples collected from the same sample source or sampling point on the same date and at the same time must be identified and labeled differently according to the requirements in 1.1.1 above if more than one sample collection technique is used to collect samples for the same analyte or group of analytes. For example, if both a bailer and a pump are used to collect samples for metals analysis, the bailer sample must be labeled to distinguish it from the pump sample.

1.1.4. The color, size, shape or material composition of sample containers and caps cannot substitute for the information required in 1.1.1. – 1.1.3 above.

1.1.5. The unique field identification code and any other information included on the container label or tag must allow the analyzing laboratory to independently determine the sample collection date, the sample collection time (for maximum holding times  $\leq 48$  hours), the sample preservation and the analytical tests to be performed on each container or group of containers.

1.2. Attach the label or tag so that it does not contact any portion of the sample that is removed or poured from the container.

1.3. Record the unique field identification code on all other documentation associated with the specific sample container or group of containers.

2. GENERAL REQUIREMENTS FOR SAMPLING DOCUMENTATION: Record the following information for all sampling:

2.1. Names of all sampling team personnel on site during sampling

2.2. Date and time of sample collection (indicate hours and minutes)

2.2.1. Use 24-hour clock time or indicate A.M. and P.M.

2.2.2. Note the exact time of collection for individual sample containers for time-sensitive analyses with a maximum holding time of 48 hours or less.

2.3. Ambient field conditions, to include, but not limited to information such as weather, tides, etc.

2.4. Comments about samples or conditions associated with the sample source (e.g., turbidity, sulfide odor, insufficient amount of sample collected)

2.5. Specific description of sample location, including site name and address

2.5.1. Describe the specific sampling point (e.g., monitoring well identification number, outfall number, station number, etc.).

2.5.2. Determine latitude and longitude of sampling source location (if required).

2.5.3. Locate sampling points on scaled maps or drawings where applicable.

2.6. Record the unique field identification code for each sample container and parameters to be analyzed, per section 1 above. The code must adequately link the sample container or group of containers with all of the information about the sample contained in the permanent field record.

2.7. Number of containers collected for each unique field identification code

2.8. Matrix sampled

2.9. Field-testing measurement data:

2.9.1. See FD 4000 above for specific details.

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- 2.10. Calibration records for field-testing equipment
  - 2.10.1. See FD 4000 above for specific details.
- 2.11. Preservation for each container
  - 2.11.1. See FD 5100, section 1.
- 2.12. Purging and sampling equipment used
- 2.13. Types, number, collection location and collection sequence of quality control samples
- 2.14. Use of fuel powered vehicles and equipment
- 2.15. Number of subsamples and amount of each subsample in any composite samples
  - 2.15.1. Include sufficient location information for the composite subsamples per 2.4 above.
- 2.16. Depth of all samples or subsamples
- 2.17. Signature(s) or initials of sampler(s)
- 3. SAMPLE TRANSMITTAL RECORDS: Transmit the following information to the analytical laboratory or other receiving party. Link transmittal records with a given project and retain all transmittal records.
  - 3.1. Site name and address
    - 3.1.1. Client code is acceptable if samples are considered sensitive information and if the field records clearly trace the code to a specified site and address.
  - 3.2. Date and time of sample collection
  - 3.3. Name of sampler responsible for sample transmittal
  - 3.4. Unique field identification codes for each sample container
  - 3.5. Total number of samples
  - 3.6. Required analyses
  - 3.7. Preservation protocol
  - 3.8. Comments about sample or sample conditions
  - 3.9. Identification of common carrier (if used)
- 4. SAMPLE TRANSPORT
  - 4.1. If shipping transmittal forms in the transport containers with the samples, place the forms in a waterproof enclosure and seal.
  - 4.2. For common carrier shipping, seal transport containers securely with strapping tape or other means to prevent lids from accidentally opening.
    - 4.2.1. Keep all shipping bills from common carriers with archived transmittal records.
- 5. ANCILLARY FIELD RECORDS: Link any miscellaneous or ancillary records (photographs, videotapes, maps, etc.) to specific sampling events such that these records are easily traceable in the data archives associated with the project, sampling date and sample source(s).

## **FD 5100. Documentation Specific To Aqueous Chemistry Sampling**

1. **SAMPLE PRESERVATION:** Document preservation of all samples according to the following instructions.

- 1.1. List the chemical preservatives added to the sample.
- 1.2. Record the results of pH verification performed in the field, including the pH value of the sample (if applicable). Note any observations about changes in the sample as a result of adding preservative to the sample or mixing the sample with the preservative.
- 1.3. Record the amount of preservative added to samples and the amount of any additional preservative added. The amount dosed into sample containers supplied with premeasured preservatives must also be recorded.
  - 1.3.1. For documentation of procedures for preservation for routine samples, cite DEP SOPs or internal SOPs for this information.
  - 1.3.2. Record instances of deviation from preservation protocols found in SOPs when non-routine or problematic samples are collected.
- 1.4. Record the use of ice or other cooling method, when applicable.

### **2. GROUNDWATER SAMPLING**

2.1. Record the following for all samples. See section 3 below for in-place plumbing:

- Purging equipment used
- Well casing composition and diameter of well casing
- Water table depth and well depth
- Calculations used to determine purge volume
- Total amount of water purged
- Date well was purged
- Sampling equipment used
- Well diameter
- Total depth of well
- Depth to groundwater
- Volume of water in the well
- Purging method
- Placement depth of tubing or pump intake
- Depth and length of screened interval
- Times for beginning and ending of purging
- Total volume purged
- Times of stabilization parameter measurements
- Purging rate, including any changes in rate

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- Temperature measurements
- pH measurements
- Specific conductance measurements
- Dissolved oxygen measurements
- Turbidity measurements
- Site or monitor well conditions impacting observed dissolved oxygen and turbidity measurements
- Color of groundwater
- Odor of groundwater

2.2. Record the following for Water Level and Purge Volume Determination (FS 2211):

- Depth to groundwater
- Total depth of well
- Length of water column
- Well diameter
- Volume of water in the well
- Volume of pump
- Tubing diameter
- Length of tubing
- Volume of flow cell
- Volume in the pumping system

2.3. Record the following for Well Purging (FS 2212)

- Calculations for pumping rates, including any changes in rates
- Flow meter readings
- Volume of water purged
- Placement depth of tubing or pump intake
- Depth and length of screened interval
- Time needed to purge one (1) well volume or purging equipment volume
- Well volumes or purging equipment volumes purged
- Temperature measurements
- pH measurements
- Specific conductance measurements
- Dissolved oxygen measurements
- Turbidity measurements
- Purging rate, including any changes in rate

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- Drawdown in the well
3. IN-PLACE PLUMBING SOURCES INCLUDING DRINKING WATER SYSTEMS
- 3.1. Record the following for all samples:
- Plumbing and tap material construction (if known)
  - Flow rate at which well was purged
  - Amount of time well was allowed to purge
  - Flow rate at time of sample collection
  - Public water system identification number (if applicable)
  - Name and address of water supply system and an emergency phone number for notification of sample results (if applicable)
4. SURFACE WATER SAMPLING
- Sample collection depth
  - Beginning and ending times (24 hr) for timed composite sampling
  - Type of composite (e.g., flow-proportioned, continuous, etc.)
5. WASTEWATER SAMPLING
- Beginning and ending times (24 hr) for timed composite sampling
  - Type of composite (e.g. flow-proportioned, continuous, etc.)

**FD 5200. Records for Non-Aqueous Environmental Samples**

Document the following information for all samples when using the indicated procedures.

**FD 5210. DOCUMENTATION SPECIFIC TO SOIL SAMPLING (FS 3000)**

1. GENERAL SOIL SAMPLING
- Sample collection depth
  - Areal location of sample
  - Sample collection device
2. SAMPLING FOR VOLATILE ORGANIC COMPOUNDS (VOC) PER EPA METHOD 5035
- Tare weight of VOC sample vial (if applicable)
  - Weight of sample (if applicable)

**FD 5220. DOCUMENTATION SPECIFIC TO SEDIMENT SAMPLING (FS 4000)**

3. GENERAL SEDIMENT SAMPLING
- Sample collection depth
  - Areal location of sample
  - Sample collection device

4. SAMPLING FOR VOLATILE ORGANIC COMPOUNDS (VOC) PER EPA METHOD 5035

- Tare weight of VOC sample vial (if applicable)
- Weight of sample (if applicable)

**FD 5300. Documentation Specific To Waste Sampling (FS 5000)**

1. DRUM SAMPLING

1.1. Record the following information for each drum:

- Type of drum and description of contents
- Drum number, if applicable
- Terrain and drainage condition
- Shape, size and dimensions of drum
- Label wording or other markings
- Dimensional extent of leaks or spills associated with the drum
- Drum location (or location map)

1.2. Record the following information for the drum sample(s):

- Description of phases, colors, crystals, powders, sludges, etc.
- Stratified layers sampled, including aliquot amounts for composites, if applicable

1.3. Record the following for field testing results on opened drums and drum samples:

- Background readings for OVA meters
- Sample readings for OVA meters
- Type of OVA probe
- Radiation background reading and sample radiation reading
- Type of radiation monitor used
- Oxygen and LEL readings from container opening
- Water reactivity results
- Specific gravity
- PCB test results
- Water solubility results
- pH of aqueous wastes
- Results of chemical test strips
- Ignitability results
- Results of other chemical hazard test kits
- Miscellaneous comments for any tests

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2. DOCUMENTATION FOR TANKS

2.1. Record the following information for the tank:

- Type of tank, tank design and material of construction of tank
- Description of tank contents and markings
- Tank number or other designation, if applicable
- Terrain and drainage condition
- Shape, size and dimensions of tank
- Label or placard wording or other markings
- Dimensional extent of leaks or spills associated with the tank
- Tank location (or location map)

2.2. Record the following information for the tank sample(s):

- Description of phases, colors, crystals, powders, sludges, etc.
- Stratified layers sampled, including aliquot amounts for composites, if applicable

2.3. Record the following for field testing results on opened tanks and tank samples:

- Background readings for OVA meters
- Sample readings for OVA meters
- Type of OVA probe
- Radiation background reading and sample radiation reading
- Type of radiation monitor used
- Oxygen and LEL level from container opening
- Water reactivity results
- Specific gravity
- PCB test results
- Water solubility results
- pH of aqueous wastes
- Results of chemical test strips
- Ignitability results
- Results of other chemical hazard test kits
- Miscellaneous comments for any tests

3. DOCUMENTATION FOR WASTE LEACHATE AND WASTE SUMP SAMPLES

3.1. Document information specific to leachate and sump sampling according to the documentation requirements for the respective FDEP SOPs employed to collect samples (FS 2100, FS 2200, FS 4000, FS 5100 and FS 5200).

4. DOCUMENTATION FOR WASTE PILE SAMPLES

4.1. Document information specific to waste pile sampling according to associated regulatory requirements for the project.

5. DOCUMENTATION FOR WASTE IMPOUNDMENT AND WASTE LAGOON SAMPLES

5.1. Document information specific to impoundment and lagoon sampling according to the documentation requirements for the respective FDEP SOPs employed to collect samples (FS 2100, FS 4000, FS 5100 and FS 5200).

## **FD 5400. Documentation For Biological Sampling**

The following SOP sections list required documentation items for specific biological sampling procedures, as indicated.

### **FD 5410. DOCUMENTATION FOR BIOLOGICAL AQUATIC HABITAT CHARACTERIZATION**

Minimum documentation required for biological habitat characterization and sampling is listed below according to requirements as specified in the indicated sampling and field-testing FDEP SOPs.

#### **FD 5411. Physical/Chemical Characterization for Biological Sampling (FT 3001)**

1. Record the following information or use the Physical/Chemical Characterization Field Sheet (Form FD 9000-3):

- STORET station number
- Sample date
- Sample location
- Field identification
- Receiving body of water
- Time of sampling
- Percentage of land-use types in the watershed that drain to the site
- Potential for erosion within the portion of the watershed that affects the site
- Local non-point-source pollution
- Width of 100-meter section of river or stream
- Size of the system or the size of the sample area within the system (lake, wetland, or estuary)
- Three measurements of water depth across the typical width transect
- Three measurements of water velocity, one at each of the locations where water depth was measured
- Vegetated riparian buffer zone width on each side of the stream or river or at the least buffered point of the lake, wetland or estuary

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- Presence of artificial channelization in the vicinity of the sampling location (stream or river)
- Presence or absence of impoundments in the area of the sampling location
- Vertical distance from the current water level to the peak overflow level
- Distance of the high water mark above the stream bed
- Percentage range that best describes the degree of shading in the sampling area
- Any odors associated with the bottom sediments
- Presence or absence of oils in the sediment
- Any deposits in the area, including the degree of smothering by sand or silt
- Temperature
- pH
- Dissolved oxygen
- Specific conductance
- Salinity
- Secchi depth
- Type of aquatic system sampled
- Description of any noticeable water odors
- Term that best describes the relative coverage of any oil on the water surface
- Term that best describes the amount of turbidity in the water
- Term that best describes the color of the water
- Weather conditions during the time of sampling
- Any other conditions/observations that may be helpful in characterizing the site
- Relative abundances of periphyton, fish, aquatic macrophytes and iron/sulfur bacteria
- Signature(s) of sampler(s)
- Sampling date

2. For streams and rivers, draw a grid sketch of the site (optionally use Form FD 9000-4), showing the location and amount of each substrate type (as observed by sight or touch). Using the grid sketch, count the number of grid spaces for each substrate type. Divide each of these numbers by the total number of grid spaces contained within the site sketch. Record this percent coverage value for each substrate type.

3. For lakes, divide the site map into twelve sections and note visual markers that may assist in distinguishing those sections.

4. Photographs of the sampling area are also useful tools for documenting habitat conditions and identifying station location.

**FD 5412. Stream and River Biological Habitat Assessment Records (FT 3100)**

1. Record the following information or use Form FD 9000-5, Stream/River Habitat Assessment Field Sheet:

- STORET station number
- Sampling date
- Sampling location
- Field identification
- Receiving body of water
- Time of sampling upon arrival at the site

2. Additionally record the following:

- Substrate diversity score
- Substrate availability score
- Water velocity score
- Habitat smothering score
- Artificial channelization score
- Bank stability score for each bank
- Riparian buffer zone width score for each bank
- Riparian zone vegetation quality score for each bank
- Primary habitat components score
- Secondary habitat components score
- Habitat assessment total score
- Signatures
- Assessment date

**FD 5413. Lake Biological Habitat Assessment Records (FT 3200)**

1. Document the following information or use the Lake Habitat Assessment Field Sheet (Form FD 9000-6):

- STORET station number
- Sampling date
- Sampling location
- Field identification number
- County name
- Lake size
- Features observed

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- Hydrology of the system (water residence time)
- Color of the lake
- Vegetation quality score
- Stormwater inputs score
- Bottom substrate quality score
- Lakeside adverse human alterations score
- Upland buffer zone score
- Adverse watershed land use score
- Habitat assessment total score
- Signature and date

**FD 5420. BIOLOGICAL AQUATIC COMMUNITY SAMPLING RECORDS (FS 7000)**

**FD 5421. Periphyton Sampling Records (FS 7200)**

2. For each sample, record the following:

- Station sampled
- Date collected

**FD 5422. Qualitative Periphyton Sampling Records (FS 7210)**

1. Complete the Physical/Chemical Characterization Field Sheet (Form FD 9000-3), Stream/River Habitat Sketch Sheet (Form FD 9000-4) or site map and Stream/River Habitat Assessment Field Sheet (Form FD 9000-5), as appropriate for the water body sampled (see FT 3000 – FT 3400). Other customized formats may be used to record the information prompted on the above forms.

**FD 5423. Rapid Bioassessment (Biorecon) Records (FS 7410)**

1. Record the following information or use the Biorecon Field Sheet (Form FD 9000-1).

- Family or genus of all organisms from all material in all four dipnet sweeps
- Total taxa tallies
- Taxa richness, Ephemeroptera taxa, Trichoptera taxa, Long-lived taxa, Clinger taxa, and Sensitive taxa
- Signatures
- Collection date

**FD 5424. Stream Condition Index (D-frame Dipnet) Sampling Records (FS 7420)**

1. Complete the Physical/Chemical Characterization Field Sheet (Form FD 9000-3), Stream/River Habitat Sketch Sheet (Form FD 9000-4) or site map and Stream/River Habitat

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Assessment Field Sheet (Form FD 9000-5) forms appropriate for the water body sampled (see FT 3000 – FT 3400). Other customized formats may be used to record the information prompted on the above forms.

2. Record the following for each sample:

- Number of sweeps for each habitat
- Number of containers per sample

**FD 5425. Sediment Core Biological Grab Sampling Records (FS 7440)**

1. Record the sampling location of site grab core samples.

**FD 5426. Sediment Dredge Biological Grab Sampling Records (FS 7450)**

1. Record the sampling location of site grab dredge samples.

**FD 5427. Lake Condition Index (Lake Composite) Sediment Dredge Biological Grab Sampling Records (FS 7460)**

1. Record the following:

- sampling location of site grab dredge sample
- sediment type(s) in each grab dredge sample

***FD 6000. (RESERVED)***

***FD 7000. LEGAL OR EVIDENTIARY DOCUMENTATION***

1. SCOPE: The use of legal or evidentiary Chain-of-Custody (COC) protocols are not usually required by DEP, except for cases involving civil or criminal enforcement. Do not use these procedures for routine sampling for compliance, for example, unless evidentiary custody protocols are specifically mandated in a permit or other legal order or when required for enforcement actions.

2. GENERAL PROCEDURAL INSTRUCTIONS

2.1. Follow applicable requirements in FD 1000 – FD 5000 for all evidence samples.

2.2. Establish and maintain the evidentiary integrity of samples and/or sample containers. Demonstrate that the samples and/or sample containers were handled and transferred in such a manner as to eliminate possible tampering.

2.2.1. Document and track all time periods and the physical possession and storage of sample containers and samples from point of origin through the final analytical result and sample disposal.

**FD 7100. General Requirements for Evidentiary Documentation**

1. CHAIN OF CUSTODY RECORDS: Use the Chain-of-Custody (COC) records to establish an intact, contiguous record of the physical possession, storage and disposal of sample containers,

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collected samples, sample aliquots, and sample extracts or digestates. For ease of discussion, the above-mentioned items are referred to as "samples".

- 1.1. Account for all time periods associated with the physical samples.
- 1.2. Include signatures of all individuals who physically handle the samples.
  - 1.2.1. The signature of any individual on any record that is designated as part of the Chain-of-Custody is their assertion that they personally handled or processed the samples identified on the record.
  - 1.2.2. Denote each signature with a short statement that describes the activity of the signatory (e.g., "sampled by", "received by", "relinquished by", etc.).
  - 1.2.3. In order to simplify recordkeeping, minimize the number of people who physically handle the samples.
2. CONSOLIDATION OF RECORDS: The COC records need not be limited to a single form or document. However, limit the number of documents required to establish COC, where practical, by grouping information for related activities in a single record. For example, a sample transmittal form may contain both certain field information and the necessary transfer information and signatures for establishing delivery and receipt at the laboratory.
3. LIABILITY FOR CUSTODY DOCUMENTATION: Ensure appropriate personnel initiate and maintain sample chain-of-custody at specified times.
  - 3.1. Begin legal chain-of-custody when the precleaned sample containers are dispatched to the field.
    - 3.1.1. Omit the transmittal record for precleaned sample containers if the same party provides the containers and collects the samples.
  - 3.2. Sign the COC record upon relinquishing the prepared sample kits or containers.
  - 3.3. Sign the COC record upon receipt of the sample kits or containers.
  - 3.4. Thereafter, ensure that all parties handling the samples maintain sample custody (i.e., relinquishing and receiving) and documentation until the samples or sampling kits are relinquished to a common carrier.
    - 3.4.1. The common carrier should not sign COC forms.
    - 3.4.2. Indicate the name of the common carrier in the COC record, when used. Retain shipping bills and related documents as part of the record.
    - 3.4.3. Ensure that all other transferors and transferees releasing or accepting materials from the common carrier sign the custody record.
  - 3.5. Chain-of-custody is relinquished by the party who seals the shipping container and is accepted by the party who opens it.
    - 3.5.1. Indicate the date and time of sealing of the transport container for shipment.
      - 3.5.1.1. See FD 7200, section 3 below regarding the use of custody seals.
4. SAMPLE SHIPPING OR TRANSPORTING
  - 4.1. Affix tamper-indicating custody seals or evidence tape before shipping samples.
    - 4.1.1. Seal sample container caps with tamper-indicating custody seals or evidence tape before packing for shipping or transport.

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4.1.2. Seal sample transport or shipping containers with strapping tape and tamper-indicating custody seals or evidence tape.

4.1.3. If the same party collects then possesses (or securely stores), packs and transports the samples from time of collection, omit any use of custody seals or evidence tape.

4.2. Keep the COC forms with the samples during transport or shipment. Place the COC records in a waterproof closure inside the sealed ice chest or shipping container.

## **FD 7200. Required Documentation for Evidentiary Custody**

1. GENERAL CONTENT REQUIREMENTS: Document the following in COC tracking records by direct entry or linkage to other records:

- Time of day and calendar date of each transfer or handling procedure
- Signatures of transferors, transferees and other personnel handling samples
- Location of samples (if stored in a secured area)
- Description of all handling procedures performed on the samples for each time and date entry recorded above
- Storage conditions for the samples, including chemical preservation and refrigeration or other cooling
- Unique identification for all samples
- Final disposition of the physical samples
- Common carrier identity and related shipping documents

2. DOCUMENTATION CONTENT FOR SAMPLE TRANSMITTAL

Provide a Chain-of-Custody record for all evidentiary samples and subsamples that are transmitted or received by any party. Include the following information in the COC record of transmittal:

- Sampling site name and address
- Date and time of sample collection
- Unique field identification code for each sample source and each sample container
- Names of personnel collecting samples
- Signatures of all transferors and transferees
- Time of day and calendar date of all custody transfers
- Clear indication of number of sample containers
- Required analyses by approved method number or other description
- Common carrier usage
- Sample container/preservation kit documentation, if applicable

3. **CHAIN-OF-CUSTODY SEALS:** If required, affix tamper-indicating evidence tape or seals to all sample, storage and shipping container closures when transferring or shipping sample container kits or samples to another party.

- 3.1. Place the seal so that the closure cannot be opened without breaking the seal.
- 3.2. Record the time, calendar date and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container.
- 3.3. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

### **FD 7300. Documenting Controlled Access to Evidence Samples**

Control and document access to all evidentiary samples and subsamples with adequate tracking. Documentation must include records about each of the activities and situations listed below, when applicable to sample evidence, and must track the location and physical handling of all samples by all persons at all times. See FS 1000 for additional discussion about procedures for handling evidence samples.

1. Limit the number of individuals who physically handle the samples as much as practicable.
2. When storing samples and subsamples, place samples in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel.
3. Alternatively, maintain restricted access to facilities where samples are stored. Ensure that unauthorized personnel are not able to gain access to the samples at any time.
4. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals.

### **FD 7400. Documenting Disposal of Evidence Samples**

1. Dispose of the physical samples only with the concurrence of the affected legal authority, sample data user and/or submitter/owner of the samples.
2. Record all conditions of disposal and retain correspondence between all parties concerning the final disposition of the physical samples.
3. Record the date of disposal, the nature of disposal (i.e., sample depleted, sample flushed into sewer, sample returned to client, etc.), and the name of the individual who performed the disposal. If samples are transferred to another party, document custody transfer in the same manner as other transfers (see FD 7000 – FD 7200).

### ***FD 8000. REFERENCES***

1. Florida Department of Environmental Protection, Standard Operating Procedures for Laboratory Operations and Sample Collection, Chapter 5.0, "Sample Custody and Documentation", DEP-QA-001/92, September 30, 1992.
2. National Environmental Laboratory Accreditation Conference, Constitution, Bylaws and Standards, "Quality Systems", Section 5.12, EPA 600/R-99/068, July 1999.

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3. U.S. Environmental Protection Agency, Good Automated Laboratory Practices, EPA 2185, 8/10/95
4. U.S. Environmental Protection Agency, Region 4, Environmental Services Division, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.
5. U.S. Environmental Protection Agency, Environmental Response Team, SOP# 2009, Rev. 0.0, Drum Sampling, 11/16/94.
6. U.S. Environmental Protection Agency, Environmental Response Team, SOP# 2010, Rev. 0.0, Tank Sampling, 11/16/94.
7. Florida Department of Environmental Protection, Bureau of Emergency Response, Division of Law Enforcement, Emergency Response Sampling Standard Operating Procedures, 1/5/99.

## ***FD 9000. FORMS***

Use the following DEP SOP Forms to facilitate documentation of sampling, field-testing and biological laboratory calculation activities. These forms are for unrestricted public use and are suggestive in format. *The use of these forms is not mandatory. However, **some of the data elements and other information denoted by the form prompts comprise required documentation items.** Not all required documentation is illustrated in the form examples.* Customize these forms as needed. These forms are available as separate document files. The respective FDEP SOPs for which they are intended are also listed below.

- Form FD 9000-1 Biorecon Field Sheet (FS 7000 and LT 7000)
- Form FD 9000-2 Composite Lake Sampling Sheet (FS 7000)
- Form FD 9000-3 Physical/Chemical Characterization Field Sheet (FT 3000)
- Form FD 9000-4 Stream/River Habitat Sketch Sheet (FT 3000)
- Form FD 9000-5 Stream/River Habitat Assessment Field Sheet (FT 3000)
- Form FD 9000-6 Lake Habitat Assessment Field Sheet (FT 3000)
- Form FD 9000-7 Field Parameter Data Sheet for Surface Water (FT 1000 - FT 2400)
- Form FD 9000-8 Field Instrument Calibration Form (FT 1100 - FT 2400)
- Form FD 9000-9 Field Instrument Maintenance Form (FT 1100 - FT 2400)
- Form FD 9000-10 LI-COR Data Sheet (FT 1700)
- Form FD 9000-11 Discharge Measurement Notes [USGS Form, 1971] (FT 1800)
- Form FD 9000-12 Residual Chlorine Spectrophotometer Maintenance Log (FT 2000)
- Form FD 9000-13 Residual Chlorine Photometer Calibration-Verification Log (FT 2000)
- Form FD 9000-14 Residual Chlorine Secondary Standard Cal-Verification Log (FT 2000)
- Form FD 9000-15 Sediment Oxygen Demand (SOD) Field Measurement Log (FT 2300)
- Form FD 9000-16 Chain-of-Custody Form for Biological Tissues (FS 6000-FS 6200)
- Form FD 9000-17 Fish/Shellfish Tissue Sample Request Form (FS 6000-FS 6200)
- Form FD 9000-18 Shellfish Contaminant Field Monitoring - Screening Study (FS 6100)

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- Form FD 9000-19 Shellfish Contaminant Field Monitoring - Intensive Study (FS 6100)
- Form FD 9000-20 Fish Contaminant Field Monitoring - Screening Study (FS 6200)
- Form FD 9000-21 Fish Contaminant Field Monitoring- Intensive Study (FS 6200)
- Form FD 9000-22 General Field Support Equipment Checklist (FM 1000)
- Form FD 9000-23 Field Sample Collection Equipment Checklist (FM 1000)
- Form FD 9000-24 Groundwater Sampling Log (FS 2200)

## ***FS 1000. GENERAL SAMPLING PROCEDURES***

See also the following Standard Operating Procedures:

- FA 1000 and 2000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000-9000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements

### **FS 1001. Preliminary Activities**

1. Begin each sampling episode with some planning and coordination. Refer to FM 1000 for recommendations and suggestions on laboratory selection and communication, and field mobilization.

1.1. FDEP recommends that a minimum of two people be assigned to a field team. In addition to safety concerns, the process of collecting the samples, labeling the containers and completing the field records is much easier if more than one person is present.

1.2. If responding to incidents involving hazardous substances, FDEP recommends that four or five people be assigned to the team.

#### **2. EQUIPMENT**

2.1. Select appropriate equipment based on the sampling source (see FS 2000 to FS 8200) and, the analytes of interest and the sampling procedure.

2.2. The equipment construction must be consistent with the analytes or analyte groups to be collected (see Tables FS 1000-1 and FS 1000-2).

2.3. Bring precleaned equipment to the field or use equipment that has been certified clean by the vendor or laboratory.

#### **3. DEDICATED EQUIPMENT STORAGE**

3.1. Store all dedicated equipment (except dedicated pump systems or dedicated drop pipes) in a controlled environment.

3.2. If possible, store equipment in an area that is located away from the sampling site. If equipment other than dedicated pumps or dedicated drop pipes are stored in monitoring wells, suspend the equipment above the formation water.

3.3. Securely seal the monitoring well in order to prevent tampering between sampling events.

3.4. Decontaminate all equipment (except dedicated pumps or drop pipes) before use according to the applicable procedures in FC 1000.

#### **4. SAMPLE CONTAINERS**

4.1. The analyses to be performed on the sample determine the construction of sample containers.

4.2. Inspect all containers and lids for flaws (cracks, chips, etc.) before use. Do not use any container with visible defects or discoloration.

## **FS 1002. Contamination Prevention and Sample Collection Order**

### **1. CONTAMINATION PREVENTION**

1.1. Take special effort to prevent cross contamination and contamination of the environment when collecting samples. Protect equipment, sample containers and supplies from accidental contamination.

1.1.1. Do not insert pump tubing, measurement probes, other implements, fingers, etc. into sample containers or into samples that have been collected for laboratory analysis.

1.1.1.1. If it is necessary to insert an item into the container or sample, ensure that the item is adequately decontaminated for the analytes of interest to be analyzed in the sample.

1.1.2. If possible, collect samples from the least contaminated sampling location (or background sampling location) to the most contaminated sampling location.

1.1.2.1. Collect the ambient or background samples first and store them in separate ice chests or shipping containers.

1.1.3. Collect samples in flowing water from downstream to upstream.

1.1.4. Do not store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same ice chest or shipping container with other environmental samples.

1.1.4.1. Isolate these sample containers by sealing them in separate, untreated plastic bags immediately after collecting, preserving, labeling, etc.

1.1.4.2. Use a clean, untreated plastic bag to line the ice chest or shipping container.

### **2. SAMPLE COLLECTION ORDER**

2.1. Unless field conditions justify other sampling regimens, collect samples in the following order:

- Volatile Organics and Volatile Inorganics
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil & Grease
- Total Metals
- Dissolved Metals
- Inorganic Nonmetallics, Physical and Aggregate Properties, and Biologicals
- Radionuclides
- Microbiological

Note: If the pump used to collect groundwater samples cannot be used to collect volatile or extractable organics, then collect all other parameters, withdraw the pump and tubing, and collect the volatile and extractable organics.

### **3. COMPOSITE SAMPLES**

3.1. Do not collect composite samples unless required by permit or FDEP program.

3.2. If compositing is required, use the following procedure:

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- 3.2.1. Select sampling points from which to collect each aliquot.
- 3.2.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.
- 3.2.3. Record the approximate amount of each aliquot (volume or weight).
- 3.2.4. Add preservative(s), if required.
- 3.2.5. Label container and make appropriate field notes (see FD 1000-9000).
- 3.2.6. Notify the laboratory that the sample is a composite sample.
- 3.2.7. When collecting soil or sediment samples, combine the aliquots of the sample directly in the sample container with no pre-mixing. Notify the laboratory that the sample is an unmixed composite sample, and request that the laboratory thoroughly mix the sample before sample preparation or analysis.

### **FS 1003. Protective Gloves**

1. Gloves serve a dual purpose to:
  - Protect the sample collector from potential exposure to sample constituents
  - Minimize accidental contamination of samples by the collector
2. The FDEP recommends wearing protective gloves when conducting all sampling activities. They must be worn except when:
  - The sample source is considered to be non-hazardous
  - The samples will not be analyzed for trace constituents
  - The part of the sampling equipment that is handled without gloves does not contact the sample source
3. Do not let gloves come into contact with the sample or with the interior or lip of the sample container.
4. Use clean, new, unpowdered and disposable gloves.
  - 4.1. FDEP recommends latex gloves, however, other types of gloves may be used as long as the construction materials do not contaminate the sample or if internal safety protocols require greater protection.
  - 4.2. Note that certain materials (as might be potentially present in concentrated effluent) may pass through certain glove types and be absorbed in the skin. Many vendor catalogs provide information about the permeability of different gloves and the circumstances under which the glove material might be applicable.
  - 4.3. The powder in powdered gloves can contribute significant contamination and FDEP does not recommend wearing powdered gloves unless it can be demonstrated that the powder does not interfere with the sample analysis.
5. If gloves are used, change:

- After preliminary activities such as pump placement;
  - After collecting all the samples at a single sampling point; or
  - If torn, or used to handle extremely dirty or highly contaminated surfaces.
6. Properly dispose of all used gloves.

#### **FS 1004. Container and Equipment Rinsing**

When collecting aqueous samples, rinse the sample collection equipment with a portion of the sample water before taking the actual sample. Sample containers do not need to be rinsed. In the case of petroleum hydrocarbons, oil & grease or containers with premeasured preservatives, the sample containers cannot be rinsed.

#### **FS 1005. Fuel-Powered Equipment and Related Activities**

1. Place all fuel-powered equipment away from, and downwind of, any site activities (e.g., purging, sampling, decontamination). If field conditions preclude such placement (i.e., the wind is from the upstream direction in a boat), place the fuel source(s) as far away as possible from the sampling activities and describe the conditions in the field notes.
2. Handle fuel (i.e., filling vehicles and equipment) prior to the sampling day. If such activities must be performed during sampling, the personnel must wear disposable gloves. Dispense all fuels, dispose of gloves downwind, and well away from the sampling activities.
3. If sampling at active gas stations, stop sample collection activities during fuel deliveries.

#### **FS 1006. PRESERVATION, HOLDING TIMES AND CONTAINER TYPES**

1. Preserve all samples according to the requirements specified in Tables FS 1000-4 through FS 1000-8.
  - 1.1. The holding times listed in the above-referenced tables supersede any preservation techniques that might be discussed in individual analytical methods.
  - 1.2. If samples are collected only for total phosphorus and are not for NPDES compliance, thermal preservation (ice) is not required if the sample containers are pre-preserved with acid.
  - 1.3. When collecting unattended automatic sample composites:
    - 1.3.1. If the collection period is 24 hours or less, the holding time begins at the last scheduled sample collection;
    - 1.3.2. If the collection period exceeds 24 hours, the holding time begins with the time that the first sample is collected.
2. The preservation protocols in the referenced tables specify immediate preservation. "Immediate" is defined as "within 15 minutes of sample collection." Perform all preservation on-site unless samples can be transported back to the laboratory within 15 minutes of collecting the sample.
3. Composite water samples are the exception to the "15-minute" criterion discussed in Section 2 above.
  - 3.1. If the sample preservation requires thermal preservation (e.g., 4°C), the automatic sampler must be able to maintain the required temperature by packed ice or refrigeration.

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- 3.2. When chemical preservation is also required, begin the preservation process within 15 minutes of the last collected sample.
- 3.3. Holding Times for Automatic Samplers:
  - 3.3.1. If the collection period is 24 hours or less, the holding time begins at the last scheduled sample collection;
  - 3.3.2. If the collection period exceeds 24 hours, the holding time begins with the time that the first sample is collected.
4. Check the pH of samples at these minimum frequencies:
  - 4.1. During the first sampling event at a particular site, check all samples that are pH-adjusted except volatile organics, and
  - 4.2. During subsequent visits to a particular site, check at least one sample per parameter group that must be pH-adjusted.
  - 4.3. If the frequency of sample collection at a specified location is greater than once per month (i.e., weekly or daily), check the pH of at least one sample per parameter group (except volatile organics) according to the following schedule:
    - 4.3.1. Weekly sampling: 1 pH check per month
    - 4.3.2. Daily sampling: 1 pH check per week
  - 4.4. If the frequency of sample collection at a specified location is once per month, check the pH of at least one sample per parameter group (except volatile organics) quarterly.
  - 4.5. Site conditions may necessitate pH checks at increased intervals.

#### **FS 1007. Preventive and Routine Maintenance**

Preventive maintenance activities are necessary to ensure that the equipment can be used to obtain the expected results and to avoid unusable or broken equipment while in the field. Equipment is properly maintained when:

- It functions as expected during mobilization; and
  - It is not a source of sample contamination (e.g., dust).
1. Follow the manufacturer's suggested maintenance activities and document all maintenance. At a minimum, FDEP recommends the activities listed on Table FS 1000-10.
  2. Maintain documentation for the following information for each piece of equipment or instrumentation. See FD 3000 also.
    - 2.1. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit employed. This may include a manufacturer name, model number, serial number, inventory number, etc.
    - 2.2. Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures and solution or parts replacement for instrument probes.
    - 2.3. Include the calendar date for the procedures performed.
    - 2.4. Record names of personnel performing the maintenance or repair tasks.
    - 2.5. Describe any malfunctions necessitating repair or service.
    - 2.6. Retain vendor service records for all affected instruments.

- 2.7. Record the following for rented equipment:
  - Rental date(s)
  - Equipment type and model or inventory number or other description
- 2.8. Retain the manufacturer's operating and maintenance instructions.

### **FS 1008. Documentation and References**

1. REFERENCES: All sampling references must be available for consultation in the field. These include:

- FDEP SOPs;
- Internal SOPs;
- Sampling and analysis plans; and/or
- Quality Assurance Project Plans.

2. DOCUMENTATION: Complete and sign all documentation (see FD 1000).

### **FS 1009. Sample Documentation and Evidentiary Custody**

#### **1. SAMPLE DOCUMENTATION**

1.1. Document all activities related to a sampling event, including sample collection, equipment calibration, equipment cleaning and sample transport.

1.2. The required documentation related to each sampling or other field activity is specified in the associated SOPs; i.e., FQ 1000, FC 1000, the FS series, and the FT series.

1.3. The documentation requirements are also summarized in FD 1000, Field Documentation. FD 1000 additionally contains a list of example forms published with the SOPs that may be used to document various activities or as templates for creating customized forms.

#### **2. LEGAL CHAIN OF CUSTODY (COC)**

The use of legal or evidentiary Chain-of-Custody (COC) protocols are not usually required by DEP, except for cases involving civil or criminal enforcement. Do not use these procedures for routine sampling for compliance unless evidentiary custody protocols are specifically mandated in a permit or other legal order or when required for enforcement actions.

Evidentiary sample custody protocols are used to demonstrate that the samples and/or sample containers were handled and transferred in such a manner as to eliminate possible tampering.

When a client or situation requires legal COC, use the procedures in FD 7000 to document and track all time periods associated with the physical possession and storage of sample containers, samples and subsamples from point of origin through the final analytical result and sample disposal.

When legal or evidentiary COC is required, samples must be:

- In the actual possession of a person who is authorized to handle the samples (e.g., sample collector, laboratory technician);
- In the view of the same person after being in their physical possession;
- Secured by the same person to prevent tampering; or

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- Stored in a designated secure area.
- 2.1. Control and document access to all evidentiary samples and subsamples with adequate tracking. Documentation must include records about each of the activities and situations listed below, when applicable to sample evidence, and must track the location and physical handling of all samples by all persons at all times.
- 2.1.1. Limit the number of individuals who physically handle the samples as much as practicable.
- 2.1.2. When storing samples and subsamples, place samples in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel.
- 2.1.3. Alternatively, maintain restricted access to facilities where samples are stored. Ensure that unauthorized personnel are not able to gain access to the samples at any time.
- 2.1.4. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals. Ice chests or other storage containers used to store sample containers in hotel rooms may be sealed instead of sealing each sample container stored within.
- 2.2. Use a Chain of Custody form or other transmittal record to document sample transfers to other parties. Other records and forms may be used to document internal activities.
- 2.3. Legal COC begins when the precleaned sample containers are dispatched to the field.
- 2.3.1. The person who relinquishes the prepared sample kits or containers and the individual who receives the sample kits or containers must sign the COC form unless the same party provides the containers and collects the samples.
- 2.3.2. All parties handling the empty sample containers and samples are responsible for documenting sample custody, including relinquishing and receiving samples, except commercial common carriers.
- 2.4. Shipping Samples under Legal COC
- 2.4.1. Complete all relevant information on the COC transmittal form or record (see FD 7200, section 2).
- 2.4.2. Internal records must document the handling of the samples and shipping containers in preparation for shipment. The names of all persons who have prepared the shipment must be recorded. All time intervals associated with handling and preparation must be accounted for.
- 2.4.3. Place the forms in a sealed waterproof bag and place in the shipping container with the samples.
- 2.4.4. Seal the shipping container with tamper-proof seals (see 2.6 below) so that any tampering can be clearly seen by the individual who receives the samples.
- 2.4.5. Note: The common carrier does not sign COC records. However, the common carrier (when used) must be identified.

**2.5. Delivering Samples to the Laboratory**

2.5.1. All individuals who handle and relinquish the sample containers must sign the transmittal form. The legal custody responsibilities of the field operations end when the samples are relinquished to the laboratory.

**2.6. Chain of Custody Seals:** If required, affix tamper-indicating evidence tape or seals to all sample, storage and shipping container closures when transferring or shipping sample container kits or samples to another party.

2.6.1. Place the seal so that the closure cannot be opened without breaking the seal.

2.6.2. Record the time, calendar date and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container.

2.6.3. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

**FS 1010. Health and Safety**

Implement all local, state and federal requirements relating the health and safety.

**FS 1011. Hazardous Wastes**

Follow all local, state and federal requirements pertaining to the storage and disposal of any hazardous or investigation-derived wastes.

1. Properly manage all investigation-derived waste (IDW) so contamination is not spread into previously uncontaminated areas.

1.1. IDW includes all water, soil, drilling mud, decontamination wastes, discarded personal protective equipment (PPE), etc. from site investigations, exploratory borings, piezometer and monitoring well installation, refurbishment, and abandonment, and other investigative activities. Containerize the IDW at the time it is generated.

1.2. Determine if the IDW must be managed as Resource Conservation and Recovery Act (RCRA) regulated hazardous waste through appropriate testing or generator knowledge. Manage all IDW that is determined to be RCRA regulated hazardous waste according to the local state and federal requirements.

1.3. Properly dispose of IDW that is not a RCRA-regulated hazardous waste but is contaminated above the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality.

1.4. IDW that is not contaminated or contains contaminants below the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality may be disposed of onsite as long as the IDW will not cause a surface water violation.

1.5. Maintain all containers holding IDW in good condition:

1.5.1. Periodically inspect the containers for damage

1.5.2. Ensure that all required labeling (DOT, RCRA, etc.) are clearly visible.

## **FS 1100. REFERENCES**

1. Florida Department of Environmental Protection, DEP Standard Operating Procedures for Laboratory Operations and Sample Collection Activities, DEP QA-001/92, September 1992.
1. U.S. Environmental Protection Agency, Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996
2. U.S. Geological Survey, National Field Manual for the Collection of Water - Quality Data: Techniques of Water-Resources Investigations, Book 9, Chapters A-1 - A-9, 1997.

**Appendix FS 1000**  
**Tables, Figures and Forms**

Table FS 1000-1	Equipment Construction Materials
Table FS 1000-2	Construction Material Selection for Equipment and Sample Containers
Table FS 1000-3	Equipment Use and Construction
Table FS 1000-4	40 CFR Part 136 Table II: Required Containers, Preservation Techniques, and Holding Times (Water/Wastewater Samples)
Table FS 1000-5	Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times for Analytes not found in 40 CFR Part 136
Table FS 1000-6	Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples.
Table FS 1000-7	Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035
Table FS 1000-8	Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II
Table FS 1000-9	Containers, Preservation and Holding Times for Biosolids Samples and Protozoans
Table FS 1000-10	Preventive Maintenance Tasks
Figure FS 1000-1	Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump

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Table FS 1000-1  
Equipment Construction Materials

Construction Material <sup>1</sup>	Acceptable Analyte Groups	Precautions
<b>Metals</b>		
316 Stainless Steel	All analyte groups. Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted. <sup>2</sup>
300-Series Stainless Steel (304, 303, 302)	Suitable for all analyte groups (if used, check for corrosion before use). Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted. <sup>2</sup> If corroded, samples may be contaminated with iron, chromium, copper or nickel. Check for compatibility with water chemistry for dedicated applications. Do not use in low pH, high chloride or high TDS waters.
Low Carbon Steel Galvanized Steel Carbon Steel	Inorganic nonmetallics only.	Coring devices are acceptable for all analyte groups <u>if</u> appropriate liners are used. Use Teflon liners for organics. Use plastic or Teflon liners for metals. Do not use if weathered, corroded or pitted. <sup>2</sup> If corroded, samples may be contaminated with iron and manganese. Galvanized equipment will also contaminate with zinc and cadmium. If used to collect large samples (e.g., dredges), organic and metal samples may be collected from portions of the interior of the collected material.
Brass	Inorganic nonmetallics only.	Do not use if weathered, corroded or pitted. <sup>2</sup>
<b>Plastics<sup>3</sup></b>		
Teflon and other fluorocarbon polymers	All analyte groups. Especially recommended for trace metals and organics.	Easily scratched. Do not use if scratched or discolored.
Polypropylene Polyethylene	All analyte groups.	Easily scratched. Do not use if scratched or discolored.
Polyvinyl chloride (PVC)	All analyte groups except extractable and volatile organics.	Do not use when collecting extractable or volatile organics samples.
Tygon, Silicone,	All analyte groups except extractable and volatile	Do not use when collecting extractable or volatile organic

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Table FS 1000-1  
Equipment Construction Materials

Construction Material <sup>1</sup>	Acceptable Analyte Groups	Precautions
Neoprene	organics.	samples. Do not use silicone if sampling for silica.
Viton	All analyte groups except extractable and volatile organics. <sup>4</sup>	Minimize contact with sample. Use only if no alternative material exists.
<b>Glass</b>		
Glass, borosilicate	All analyte groups except silica and boron.	

Adapted from USGS Field Manual, Chapter 2, January 2000.

<sup>1</sup> Refers to construction material of the portions of the sampling equipment that come in contact with the sample (e.g., housing of variable speed submersible pump must be stainless steel if extractable organics are sampled; the housing of a variable speed submersible pump used to sample metals may be plastic.)

<sup>2</sup> Corroded/weathered surfaces are active sorption sites for organic compounds.

<sup>3</sup> Plastics used in connection with inorganic trace element samples (including metals) must be uncolored or white.

<sup>4</sup> May be allowable for specialized parts where no alternative material exists (e.g., Viton seals are the best available seal for some dedicated pump systems), however, contact with the sample must be minimized.

**Table FS 1000-2**  
**Construction Material Selection for Equipment and Sample Containers**

<b>Analyte Group</b>	<b>Acceptable Materials</b>
Extractable Organics	Teflon Stainless steel Glass Polypropylene Polyethylene All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Volatile Organics	Teflon Stainless steel Glass Polypropylene Polyethylene All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Metals	Teflon Stainless steel Polyethylene, including HDPE Polypropylene Tygon, Viton, Silicone, Neoprene PVC Glass (except silica and boron)
Ultratrace Metals	Teflon Polyethylene, including HDPE Polypropylene Polycarbonate Mercury must be in glass or Teflon
Inorganic Nonmetallics	Teflon Stainless steel Low carbon, Galvanized or Carbon steel Polyethylene, including HDPE Polypropylene Tygon, Viton, Silicone, Neoprene PVC Glass Brass

**Table FS 1000-2**  
**Construction Material Selection for Equipment and Sample Containers**

<b>Analyte Group</b>	<b>Acceptable Materials</b>
Microbiological samples	Teflon Stainless steel Polyethylene, including HDPE Polypropylene Tygon, Viton, Silicone, Neoprene PVC Glass Sterilize all <b>sample</b> containers. Thoroughly clean <b>sampling equipment</b> and rinse several times with sample water before collection. Sampling equipment <b>does not</b> <b>require</b> sterilization <b>Do not rinse sample containers</b>

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**Table FS 1000-3**  
**Equipment Use and Construction**

<u>EQUIPMENT</u>	<u>CONSTRUCTION</u> <u>HOUSING<sup>2</sup></u>	<u>USE</u> <u>TUBING<sup>2</sup></u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
<b>WATER SAMPLING</b>				
<b>GROUNDWATER</b>				
1. Positive displacement pumps <sup>3</sup>				
a. Submersible (turbine, helical rotor, gear driven)				
	SS, Teflon	Purging	All analyte groups	4, 5, 6; must be variable speed
	SS, Teflon	Sampling	All analyte groups	4, 5, 6; must be variable speed
	Non-inert <sup>1</sup>	Purging	All analyte groups	4, 5, 6; must be variable speed; polishing required <sup>8</sup>
	Non-inert <sup>1</sup>	Sampling	All analyte groups except volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
	Non-inert <sup>1</sup>	Purging	All analyte groups	4, 5, 6; must be variable speed; polishing required <sup>8</sup>
	Non-inert <sup>1</sup>	Sampling	All analyte groups except volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
b. Bladder pump (no gas contact)				
	SS, Teflon, PE, PP or PVC if permanently installed	Purging	All analyte groups	4, 5, 6; must be variable speed
		Sampling	All analyte groups	4, 5; must be variable speed Bladder must be Teflon if sampling for volatile or extractable organics or PE if used in portable pumps
	SS, Teflon, PE, PP	Purging	All analyte groups	4, 5; must be variable speed; polishing required <sup>8</sup>
	Non-inert <sup>1</sup>	Sampling	All analyte groups except volatile and extractable organics	<u>This configuration is not recommended</u> 4, 5; must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
	Non-inert <sup>1</sup>	Purging	All analyte groups	4, 5; must be variable speed; polishing required <sup>8</sup>
	Non-inert <sup>1</sup>	Sampling	All analyte groups except volatile and extractable organics	4, 5; must be variable speed; polishing required <sup>8</sup> If sampling for metals, the tubing must be non-metallic if not SS

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**Table FS 1000-3**  
**Equipment Use and Construction**

<u>EQUIPMENT</u>	<u>CONSTRUCTION</u>		<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
	<u>HOUSING<sup>2</sup></u>	<u>TUBING<sup>2</sup></u>			
2. Section lift pumps					
a. Centrifugal	N/A	SS, Teflon, PE, PP	Purging	All analyte groups	<sup>5</sup> ; foot-valve required Must be variable speed
	N/A	Non-inert <sup>7</sup>	Purging	All analyte groups	<sup>5</sup> ; foot-valve required; polishing required <sup>8</sup> Must be variable speed
b. Peristaltic	N/A	SS, Teflon, PE, PP	Purging	All analyte groups	<sup>5</sup> ; foot-valve required; polishing required <sup>8</sup> or continuous pumping required Must be variable speed
			Sampling	All analyte groups <u>except</u> volatile and extractable organics	<sup>5</sup> ; Silicone tubing in pump head Must be variable speed
				Extractable organics	<sup>5</sup> ; configured as specified in Figure FS 1000-1 or use tubing constructed with approved materials in the pump head
	N/A	Non-inert <sup>7</sup>	Purging	All analyte groups	<sup>5</sup> ; foot-valve required Must be variable speed
			Sampling	All analyte groups <u>except</u> volatile and extractable organics	<sup>5</sup> ; Silicone tubing in pump head Must be variable speed
3. Bailers					
	SS, Teflon, PE, PP	N/A	Purging	All analyte groups	None; <b>not recommended</b>
		N/A	Sampling	All analyte groups	None; <b>not recommended</b>
	Non-inert <sup>7</sup>	N/A	Purging	All analyte groups <u>except</u> volatile and extractable organics	None; <b>not recommended</b> If sampling for metals, the tubing must be non-metallic if not SS
			Sampling	All analyte groups <u>except</u> volatile and extractable organics	None; <b>not recommended</b> If sampling for metals, the tubing must be non-metallic if not SS
SURFACE WATER					
1. Intermediate containers such as pond sampler, scoops, beakers, buckets, and dippers	SS, Teflon, Teflon-coated, HDPE, PP	N/A	Grab sampling	All analyte groups	None
	Glass	N/A		All analyte groups except boron and	None

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<u>EQUIPMENT</u>	<u>CONSTRUCTION</u> <u>HOUSING<sup>2</sup></u>	<u>USE</u> <u>TUBING<sup>2</sup></u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
	Non-inert <sup>1</sup>	N/A	fluoride All analyte groups except volatile and extractable organics	None
2. Nansen, Kemmerer, Van Dorn, Alpha and Beta Samplers, Niskin (or equivalent)	SS, Teflon, Teflon-coated, HDPE, PP	N/A	Specific depth grab sampling All analyte groups	None
	Non-inert <sup>1</sup>	N/A	All analyte groups except volatile and extractable organics	None
3. DO Dunker	SS, Teflon, glass, HDPE, PP	N/A	Water column composite sampling All analyte groups	None
4. Bailers – double valve	SS, Teflon, HDPE, PP	N/A	Grab sampling All analyte groups	None
	Non-inert <sup>1</sup>	N/A	Grab sampling All analyte groups except volatile and extractable organics	None If sampling for metals, the tubing must be non-metallic if not SS
5. Peristaltic pump	N/A	SS, Teflon, PE, PP	Specific depth sampling All analyte groups except volatile and extractable organics	Silicone tubing in pump head Must be variable speed
	N/A	Non-inert <sup>1</sup>	Extractable organics All analyte groups except volatile and extractable organics	<sup>5</sup> , configured as specified in Figure FS 1000-1, or use tubing constructed with approved materials in the pump head Silicone tubing in pump head Must be variable speed
<u>FIELD FILTRATION UNITS</u>				
	N/A	Dissolved constituents	Inorganic nonmetallics and metals in surface water	Must use a 0.45 µm filter
			Inorganic nonmetallics in groundwater	Must use a 0.45 µm filter
			Metals in groundwater and static	Must use in-line, high capacity, one-

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<u>EQUIPMENT</u>	<u>CONSTRUCTION</u> <u>HOUSING<sup>2</sup></u>	<u>USE</u> <u>TUBING<sup>2</sup></u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
			wastewater and surface water	piece molded filter that is connected to the outlet of a pump; no intermediate vessels; positive pressure HDPE & Teflon bailers acceptable Must use a 1 µm filter in groundwater, a 0.45 µm filter in surface water
			Metals in moving surface water (i.e., river/stream)	Must use positive pressure device, but an intermediate vessel may be used. Use a 0.45 µm filter
<b>SOLID SAMPLING</b>				
<b>SOILS</b>				
1. Core barrel (or liner)	SS, Teflon, glass, Teflon-coated, aluminum, PE, PP Non-inert <sup>7</sup> nonmetallics Non-inert <sup>7</sup> metals	N/A  N/A N/A	Sampling  Sampling Sampling	10, 11, 12  13 13
2. Trowel, scoop, spoon or spatula	SS, Teflon, Teflon-coated, HDPE, PP  Plastic	N/A  N/A	Sampling Compositing Sampling and compositing	All analyte groups <sup>9</sup> All analyte groups except volatile organics All analyte groups except volatile and extractable organics Samples for volatile organics must grab samples None Must be nonmetallic if not SS
3. Mixing tray (pan)	SS, Teflon, glass, Teflon-coated, aluminum, HDPE, PP  Non-inert <sup>7</sup>	N/A  N/A	Sampling  Compositing or homogenizing Compositing or	12  12 11, 12, 13; must be nonmetallic if not SS

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**Table FS 1000-3**  
**Equipment Use and Construction**

<u>EQUIPMENT</u>	<u>CONSTRUCTION</u>		<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>		<u>RESTRICTIONS AND PRECAUTIONS</u>
	<u>HOUSING<sup>2</sup></u>	<u>TUBING<sup>2</sup></u>				
			homogenizing			
4. Shovel, bucket auger	SS	N/A	Sampling	All analyte groups <sup>9</sup>		None
	Non-SS	N/A	Sampling	All analyte groups <sup>9</sup>		11, 12, 13
5. Split spoon	SS or carbon steel w/ Teflon insert	N/A	Sampling	All analyte groups <sup>9</sup>		11, 12, 13
6. Shelby tube	SS	N/A	Sampling	All analyte groups <sup>9</sup>		10
	Carbon steel	N/A	Sampling	All analyte groups		10, 11, 13
<u>SEDIMENT</u>						
1. Coring devices	SS, Teflon, glass, Teflon-coated, aluminum, HDPE, PP	N/A	Sampling	All analyte groups <sup>9</sup>		10, 11, 12
	Non-inert <sup>1</sup> nonmetallics	N/A	Sampling	All analyte groups		13
	Non-inert <sup>1</sup> metals	N/A				11, 12, 13
2. Grab – Young, Petersen, Shippek	Teflon, Teflon-lined, SS	N/A	Sampling	All analyte groups <sup>9</sup>		None
	Carbon steel	N/A	Sampling	All analyte groups		11, 12
3. Dredges – Eckman, Ponar, Petit Ponar Van Veen	SS	N/A	Sampling	All analyte groups <sup>9</sup>		None
	Carbon steel, brass	N/A	Sampling	All analyte groups		11, 12
4. Trowel, scoop, spoon or spatula	SS, Teflon, Teflon- coated, HDPE, PP	N/A	Sampling	All analyte groups <sup>9</sup>		
			Compositing	All analyte groups except volatile organics	Samples for volatile organics be grab samples	
	Plastic	N/A	Sampling and compositing	All analyte groups except volatile and extractable organics	None	must be nonmetallic if not SS
5. Mixing tray (pan)	SS, Teflon, glass,	N/A	Sampling	All analyte groups <sup>9</sup>		12

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<u>EQUIPMENT</u>	<u>CONSTRUCTION</u>		<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>		<u>RESTRICTIONS AND PRECAUTIONS</u>
	<u>HOUSING<sup>2</sup></u>	<u>TUBING<sup>2</sup></u>				
	Teflon-coated, aluminum, HDPE, PP			Compositing or homogenizing	All analyte groups except volatile organics <sup>12</sup>	
	Non-inert <sup>1</sup>	N/A		Compositing or homogenizing	All analyte groups except volatile and extractable organics	none <sup>12</sup> , must be nonmetallic if not SS
<b>WASTE<sup>14</sup></b>						
Scoop	SS	N/A		Liquids, solids & sludges	All analyte groups <sup>9</sup>	Cannot collect deeper phases
Spoon	SS	N/A		Solids, sludges	All analyte groups <sup>9</sup>	Cannot collect deeper phases
Push tube	SS	N/A		Solids, sludges	All analyte groups <sup>9</sup>	Cannot collect deeper phases
Auger	SS	N/A		Solids	All analyte groups <sup>9</sup>	None
Sediment sampler	SS	N/A		Impoundments, piles	All analyte groups <sup>9</sup>	None
Ponar dredge	SS	N/A		Solids, sludges & sediments	All analyte groups <sup>9</sup>	None
Colliwasa, Drum thief	Glass	N/A		Liquids, sludges	All analyte groups	None
Mucksucker, Dipstick	Teflon			Liquids, sludges	All analyte groups	Not recommended for tanks > 11 feet deep
Bacon bomb	SS	N/A		Liquids	All analyte groups <sup>9</sup>	Not recommended for viscous wastes
Bailer	SS, Teflon	N/A		Liquids	All analyte groups <sup>9</sup>	Do not use with heterogeneous wastes Not recommended for viscous wastes
Peristaltic pump with vacuum trap <sup>15</sup>	N/A	Teflon, Glass		Liquids	All analyte groups except volatile organics	Do not use in flammable atmosphere Not recommended for viscous wastes

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<u>EQUIPMENT</u>	<u>CONSTRUCTION</u>		<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
	<u>HOUSING<sup>2</sup></u>	<u>TUBING<sup>2</sup></u>			
Backhoe bucket	Steel	N/A	Solids, Sludges		Difficult to clean Volatiles and metals must be taken from the interior part of the sample
Split spoon	SS	N/A	Solids	All analyte groups <sup>9</sup>	
Roto-Hammer	Steel	N/A	Solids	All analyte groups <sup>9</sup>	Physically breaks up sample Not for flammable atmospheres

Acronyms:

N/A not applicable  
SS stainless steel  
HDPE high-density polyethylene  
PE polyethylene  
PVC polyvinyl chloride  
PP polypropylene

<sup>2</sup> Refers to tubing and pump housings/internal parts that are in contact with purged or sampled water (interior and exterior of delivery tube, inner lining of the discharge tube, etc.).

<sup>3</sup> If used to collect volatile or extractable organics, all power cords and other tubing must be encased in Teflon, PE or PP.

<sup>4</sup> If used as a non-dedicated system, pump must be completely disassembled, if practical, and cleaned between wells.

<sup>5</sup> Delivery tubing must be pre-cleaned and precut at the base of operations or laboratory. If the same tubing is used during the sampling event, it must be cleaned and decontaminated between uses.

<sup>6</sup> In-line check valve required.

<sup>7</sup> "Non-inert" pertains to materials that are reactive (adsorb, absorb, etc.) to the analytes being sampled. For organics, materials include rubber, plastics (except PE and PP), and PVC. For metals, materials include brass, galvanized, and carbon steel.

<sup>8</sup> "Polishing": When purging for volatile or extractable organics, the entire length of tubing or the portion which comes in contact with the formation water must be constructed of Teflon, SS, PE or PP. If other materials (e.g., PVC, garden hoses, etc.) are used, the following protocols must be followed: 1) slowly withdraw the pump from the water column during the last phase of purging, to remove any water from the well that may have contacted the exterior of the pump and/or

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tubing; 2) remove a single well volume with the sampling device before sampling begins. **Do not use Tygon** for purging if purgeable or extractable organics are of interest. Polishing is **not recommended**; use of sampling equipment constructed of appropriate materials is preferred.

<sup>9</sup> Do not use if collecting for hexavalent chromium (Chromium<sup>+6</sup>)

<sup>10</sup> If samples are sealed in the liner for transport to the laboratory, the sample for VOC analysis must be taken from the interior part of the core.

<sup>11</sup> If a non-stainless steel (carbon steel, aluminum) liner, core barrel or implement is used, take the samples for metals, purgeable organics and organics from the interior part of the core sample.

<sup>12</sup> Aluminum foil, trays or liners may be used only if aluminum is not an analyte of interest.

<sup>13</sup> If non-inert-liner, core barrel or implement is used, take samples from the interior part of the collected sample.

<sup>14</sup> If disposable equipment of alternative construction materials is used, the construction material must be compatible with the chemical composition of the waste, cannot alter the characteristics of the waste sample in any way, and cannot contribute analytes of interest or any interfering components.

<sup>15</sup> Peristaltic pump may be used without vacuum trap assembly if the tubing used in the pump head is constructed with approved materials.

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40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times  
(Water/Wastewater Samples)

Parameter No./name	Container <sup>16</sup>	Preservation <sup>17,18</sup>	Maximum holding time <sup>19</sup>
Table IA--Bacteria Tests:			
1-4. Coliform, fecal and total	P, G	Cool, 4°C, 0.008% Na2S2O3 <sup>20</sup>	6 hours.
5. Fecal streptococci	P, G	Cool, 4°C, 0.008% Na2S2O3 <sup>23</sup>	6 hours.
Table IA--Aquatic Toxicity Tests:			
6-10. Toxicity, acute and chronic.	P, G	Cool, 4°C <sup>21</sup>	36 hours
Table IB--Inorganic Tests:			
1. Acidity	P, G	Cool, 4°C	4 days.
2. Alkalinity	P, G	do	Do.
4. Ammonia	P, G	Cool, 4°C, H2SO4 to pH < 2	28 days.
9. Biochemical oxygen demand	P, G	Cool, 4°C	48 hours.
10. Boron	P, PFTE, or Quartz	HNO3 to pH<2	6 months.
11. Bromide	P, G	None required	28 days.
14. Biochemical oxygen demand, carbonaceous.	P, G	Cool, 4°C	48 hours.
15. Chemical oxygen demand	P, G	Cool, 4°C, H2SO4 to pH < 2	28 days.
16. Chloride	P, G	None required	Do.
17. Chlorine, total residual	P, G	do	Analyze immediately.
21. Color	P, G	Cool, 4°C	48 hours.

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Parameter No./name	Container <sup>16</sup>	Preservation <sup>17,18</sup>	Maximum holding time <sup>19</sup>
23-24. Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH > 12, 0.6g ascorbic acid <sup>23</sup>	14 days <sup>22</sup>
25. Fluoride	P	None required	28 days.
27. Hardness	P, G	HNO <sub>3</sub> to pH < 2, H <sub>2</sub> SO <sub>4</sub> to pH < 2	6 months.
28. Hydrogen ion (pH)	P, G	None required	Analyze immediately.
31, 43. Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days.
Metals: <sup>23</sup>			
10. Boron	P (PFTE), or Quartz	HNO <sub>3</sub> TO pH < 2	6 months.
18. Chromium VI <sup>26</sup>	P, G	Cool, 4°C	24 hours.
35. Mercury <sup>24</sup>	P, G	HNO <sub>3</sub> to pH<2	28 days.
3, 5-8, 12, 13, 19, 20, 22, 26, 29, 30, 32-34, 36, 37, 45, 47, 51, 52, 58-60, 62, 63, 70-72, 74, 75. Metals except boron, chromium VI and mercury <sup>26</sup>	P, G	do.	6 months.
38. Nitrate	P, G	Cool, 4°C	48 hours.
39. Nitrate-nitrite	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days.
40. Nitrite	P, G	Cool, 4°C	48 hours.
41. Oil and grease	G	Cool to 4°C, HCl or H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days.
42. Organic Carbon	P, G	Cool to 4°C, HCl or H <sub>2</sub> SO <sub>4</sub> or	28 days.

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40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times  
(Water/Wastewater Samples)

Parameter No./name	Container <sup>16</sup>	Preservation <sup>17,18</sup>	Maximum holding time <sup>19</sup>
44. Orthophosphate	P, G	H <sub>3</sub> PO <sub>4</sub> , to pH < 2	
46. Oxygen, Dissolved Probe	G Bottle and top.	Filter immediately, Cool 4°C	48 hours.
47. Winkler	do	None required	Analyze immediately.
48. Phenols	G only	Fix on site and store in dark.	8 hours.
49. Phosphorus (elemental)	G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days.
50. Phosphorus, total	P, G	Cool, 4°C	48 hours.
53. Residue, total	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days.
54. Residue, Filterable	P, G	Cool, 4°C	7 days.
55. Residue, Nonfilterable (TSS)	P, G	do	7 days.
56. Residue, Settleable	P, G	do	48 hours.
57. Residue, volatile	P, G	do	7 days.
61. Silica	P, PFTE, or Quartz	Cool, 4°C	28 days.
64. Specific conductance	P, G	do	Do.
65. Sulfate	P, G	do	Do.
66. Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH < 9.	7 days.
67. Sulfite	P, G	None required	Analyze immediately.
68. Surfactants	P, G	Cool, 4°C	48 hours.
69. Temperature	P, G	None required	Analyze.

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**40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times**  
(Water/Wastewater Samples)

Parameter No./name	Container <sup>16</sup>	Preservation <sup>17,18</sup>	Maximum holding time <sup>19</sup>
73. Turbidity	P, G	Cool, 4°C	48 hours.
<b>Table IC--Organic Tests<sup>25</sup></b>			
13, 18-20, 22, 24-28, 34-37, 39-43, 45-47, 56, 76, 104, 105, 108-111, 113. Purgeable Halocarbons	G, Teflon-lined septum.	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>23</sup>	14 days.
6, 57, 106 Purgeable aromatic hydrocarbons.....	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , <sup>23</sup> HCl to pH <sup>26</sup> .	Do.
3, 4 Acrolein and acrylonitrile	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , <sup>23</sup> adjust pH to 4-5 <sup>27</sup> .	Do.
23, 30, 44, 49, 53, 77, 80, 81, 98, 100, 112. Phenols <sup>28</sup>	G, Teflon-lined cap.	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>23</sup>	7 days until extraction; 40 days after extraction
7, 38. Benzidines <sup>29</sup> .	do	do	7 days until extraction <sup>13</sup> <sup>30</sup>
14, 17, 48, 50-52. Phthalate esters <sup>14</sup> .	do	Cool, 4°C	7 days until extraction; 40 days after extraction.
82-84. Nitrosamines <sup>31, 31</sup>	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>23</sup> store in dark.	Do.
88-94. PCBs <sup>31</sup>	do	Cool, 4°C	Do.
54, 55, 75, 79. Nitroaromatics and isophorone <sup>31</sup>	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , <sup>23</sup> store in dark.	Do.
1, 2, 5, 8-12, 32, 33, 58, 59, 74, 78, 99, 101. Polynuclear aromatic hydrocarbons <sup>31</sup>	do	do	Do.
15, 16, 21, 31, 87.	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>23</sup>	Do.

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**40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times**  
(Water/Wastewater Samples)

Parameter No./name	Container <sup>16</sup>	Preservation <sup>17,18</sup>	Maximum holding time <sup>19</sup>
Haloethers <sup>31</sup>			
29, 35-37, 63-65, 73, 107, Chlorinated hydrocarbons <sup>31</sup>	do	Cool, 4°C	Do.
60-62, 66-72, 85, 86, 95-97, 102, 103. CDDs/CDFs <sup>31</sup> aqueous: field and lab preservation	G	Cool, 0-4°C, pH<9, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>23</sup>	1 year.
Solids, mixed phase, and tissue: field preservation	do	Cool, <4°C	7 days.
Solids, mixed phase, and tissue: lab preservation.	do	Freeze, <-10°C	1 year.
Table ID--Pesticides Tests:			
1-70. Pesticides <sup>31</sup>	do	Cool, 4°C, pH 5-9 <sup>32</sup>	Do.
Table IE--Radiological Tests:			
1-5. Alpha, beta and radium	P, G	HNO <sub>3</sub> to pH <2	6 months.

Reference: This table is adapted from 40 CFR §136.2, Table II, Dated July 1, 2003.

<sup>16</sup> Polyethylene (P) or glass (G). For microbiology, plastic sample containers must be made of sterilizable materials (polypropylene or other autoclavable plastic), except for samples collected for trace-level mercury (see footnote 27).

<sup>17</sup> Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed, except for samples collected for trace-level mercury (see footnote 27).

<sup>18</sup> When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about

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(Water/Wastewater Samples)

1.96 or greater); Nitric acid (HNO<sub>3</sub>) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

19 Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. (See footnote 27 for samples collected for trace level mercury). Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under §136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See §136.3(e) for details. The term "analyze immediately" usually means within 15 minutes or less of sample collection.

20 Should only be used in the presence of residual chlorine.

21 Sufficient ice should be placed with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, it is necessary to immediately measure the temperature of the samples and confirm that the 4°C temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature cannot be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature.

22 Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

23 Samples should be filtered immediately on site before adding preservative for dissolved metals, except for samples collected for trace-level mercury (see footnote 27).

24 Samples collected for the determination of trace level mercury (100 ng/L) using EPA Method 1631 must be collected in tightly-capped fluoropolymer or glass bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. Samples collected for dissolved trace level mercury should be filtered in the laboratory. However, if circumstances prevent overnight shipment, samples should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. Samples that have been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.

25 Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

26 Sample receiving no pH adjustment must be analyzed within seven days of sampling.

27 The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

28 When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 32, 33 (re the analysis of benzidine).

**Table FS1000-4**

**40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times  
(Water/Wastewater Samples)**

- 
- 29 If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to  $4.0 \pm 0.2$  to prevent rearrangement to benzidine.
- 30 Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- 31 For the analysis of diphenylnitrosamine, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- 32 The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.

**Table FS 1000-5**  
**Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times**  
**For Analytes not Found in 40 CFR 136**

Analyte	Methods	Reference	Container	Preservation	Maximum Holding Time
Bromine	DPD Colorimetric <sup>33</sup>	SM 4500-Cl-G	P, G	None required	Analyze immediately
Bromates	Ion Chromatography	EPA 300.0 <sup>33</sup>	P, G	Cool 4°C	30 days
Chlorophylls	Spectrophotometric	SM 10200 H	P, G <sup>33</sup>	Dark 4°C Filtered, dark, -20°C	24 – 48 hours 21 days <sup>40</sup>
Corrosivity	Calculated (CaCO <sub>3</sub> Stability, Langlier Index)	SM 2330 ASTM D513-92	P, G	Cool 4°C <sup>41</sup>	7 days <sup>41</sup>
FL-PRO	Gas Chromatography	DEP (11/1/95)	G only	Cool 4°C, H <sub>2</sub> SO <sub>4</sub> or HCl to pH<2	7 days until extraction, 40 days after extraction
Odor	Human Panel	SM 2150	G only	Cool 4°C	6 hours
Salinity	Electrometric <sup>42</sup> Hydrometric <sup>42</sup>	SM 2520 B SM 2520 C	G, wax seal	Analyze immediately or use wax seal	30 days <sup>42</sup>
Taste	Human Panel	SM 2160 B, C, D ASTM E679-91	G only	Cool 4°C	24 hours
Total Dissolved Gases	Direct-sensing Membrane- diffusion	SM 2810	_____	_____	Analyze in-situ
Total Petroleum Hydrocarbons	Gravimetry	EPA 1664	G only	Cool 4°C, H <sub>2</sub> SO <sub>4</sub> or HCl to pH<2	28 days
Transparency	Irradiometric <sup>43</sup>	62-302.200(6), FAC	_____	_____	Analyze in-situ
Un-ionized Ammonia	Calculated <sup>44</sup>	FDEP-SOP <sup>45</sup>	P, G	Cool 4°C Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>44</sup>	8 hours unpreserved 28 days preserved <sup>44</sup>
Organic Pesticides <sup>46</sup>	GC and HPLC	EPA (600-series) <sup>46</sup>	<sup>47</sup>	<sup>47</sup>	<sup>47</sup>

<sup>33</sup> SM XXXX = procedures from "Standard Methods for the Examination of Water and Wastewater", APHA-AWWA-WPCF, 20<sup>th</sup> edition, 1998.

Table FS 1000-5

**Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times  
For Analytes not Found in 40 CFR 136**

ASTM XXXX-YY = procedure from "Annual Book of ASTM Standards", Volumes 11.01 and 11.02 (Water I and II), 1999.

<sup>34</sup> P = plastic, G = glass.

<sup>35</sup> When specified, sample preservation should be performed immediately upon sample collection.

<sup>36</sup> The times listed are the maximum times that samples may be held before analysis and still be considered valid.

<sup>37</sup> The approved procedure is for residual chlorine. However, in the absence of chlorine, the DPD colorimetric procedure can be adapted to measure bromine content of the sample. In such case, the validity of this assumption must be verified by using another procedure for chlorine which is not affected by the presence of bromine (i.e., negligible interference).

<sup>38</sup> The Determination of Inorganic Anions in Water by Ion Chromatography", EPA Method 300.0, Revised August 1993, by John D. Pfaff, U. S. EPA Cincinnati, Ohio 45268.

<sup>39</sup> Collect samples in opaque bottles and process under reduced light. Samples on filter taken from water having pH 7 or higher may be placed in airtight plastic bags and stored frozen for up to three weeks. Samples from acidic water must be processed promptly to prevent chlorophyll degradation.

<sup>40</sup> To extend holding time, samples must be filtered within 24 hours of collection. Add magnesium carbonate to the filter while the last of the sample passes through the filter. Analyze immediately or freeze up to 21 days.

<sup>41</sup> Temperature and pH must be measured on site at the time of sample collection. 7 days is the maximum time for laboratory analysis of total alkalinity, calcium ion and total solids.

<sup>42</sup> The electrometric and hydrometric analytical methods are suited for field use. The argentometric method is suited for laboratory use. Samples collected for laboratory analysis, when properly sealed with paraffin waxed stopper, may be held indefinitely. The maximum holding time of 30 days is recommended as a practical regulatory limit.

<sup>43</sup> Transparency in surface waters is defined as a compensation point for photosynthetic activity, i.e., the depth at which one percent of the light intensity entering at the water surface remains unabsorbed. The FDEP Chapter 62-302, FAC requires that the light intensities at the surface and subsurface be measured simultaneously by irradiance meters such as the Kahlsico Underwater Irradiometer, Model No. 268 WA 310, or an equivalent device having a comparable spectral response.

<sup>44</sup> The results of the measurements of pH, temperature, salinity (if applicable) and the ammonium ion concentration in the sample are used to calculate the concentration of ammonia in the unionized state. Temperature, pH and salinity must be measured on-site at the time of sample collection. Laboratory analysis of the ammonium ion concentration should be conducted within eight hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H<sub>2</sub>SO<sub>4</sub> to pH between 1.5 and 2. Acid-preserved samples, stored at 4°C, may be held up to 28 days for ammonia determination. Sodium thiosulfate should only be used if fresh samples contain residual chlorine.

<sup>45</sup> FDEP Central Analytical Laboratory, Tallahassee, FL, Revision No. 1, October 3, 1983. The 1983 draft is available from the FDEP Bureau of Laboratories.

<sup>46</sup> Other pesticides listed in approved EPA methods (608.1, 608.2, 614, 614.1, 615, 617, 618, 619, 622, 622.1, 627, 629, 631, 632, 632.1, 633, 642, 643, 644 and 645) that are not included in Table ID of 40 CFR Part 136 (July 1989).

<sup>47</sup> Container, preservation and holding time as specified in each individual method must be followed.

Table FS 1000-6

**Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples**

Analyte	Methods	References	Container	Preservation	Maximum Holding Times
Volatile Organics	Purge-and-Trap GC and GC-MS	8015, 8260, 8021, 5035		See Table 1000-7	
Semivolatile Organics	GC, HPLC, and GC-MS	8041, 8061, 8070, 8081, 8082, 8091, 8111, 8121, 8131, 8141, 8151, 8270, 8275, 8280, 8290, 8310, 8315, 8316, 8318, 8321, 8325, 8330, 8331, 8332, 8410, 8430, 8440, FL-PRO	Glass, 8 oz widemouth with Teflon®-Lined lid	Cool 4°C <sup>48</sup>	14 days until extraction, 40 days after extraction
Total Metals-except mercury and chromium VI methods	Flame AA, Furnace AA, Hydride and ICP	All 7000-series (except 7195, 7196, 7197, 7198, 7470 and 7471), and 6010 (ICP)	Glass or plastic 8 oz widemouth (200 grams sample)	Cool 4°C <sup>48</sup>	6 months
Chromium VI	Colorimetric, Chelation with Flame AA (200 gram sample)	7196 and 7197 (prep 3060)	Glass or plastic, 8 oz widemouth (200 gram sample)	Cool 4°C <sup>48</sup>	1 month until extraction, 4 days after extraction <sup>48</sup>
Mercury	Manual Cold Vapor AA	7471	Glass or plastic 8 oz widemouth (200 grams sample)	Cool 4°C <sup>48</sup>	28 days
Microbiology (MPN)		MPN	Sterile glass or plastic	Cool 4°C <sup>48</sup>	24 hours
Aggregate Properties			Glass or plastic	Cool 4°C <sup>48</sup>	14 days
Inorganic nonmetallics all except: Sulfite, Nitrate, Nitrite & o-phosphate Elemental Phosphorus			Glass or plastic	Cool 4°C <sup>48</sup>	28 days
					48 hours
			Glass		48 hours

Adapted from Table 3-1 and 4-1 in Test Methods for Evaluating Solid Waste, SW 846, EPA, Third Editions 1986 as amended by Update III, 1996 and ASTM E 1391-94. The term "residuals" included: (1) concentrated waste samples and (2) sludges of domestic or industrial origin

**Table FS 1000-6**

**Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples**

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<sup>48</sup> Keep soils, sediments and sludges cool at 4°C from collection time until analysis. No preservation is required for concentrated waste samples.

<sup>49</sup> Storage Temperature is 4°C,  $\pm 2^{\circ}\text{C}$

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035

Conc. Level	Sampling Device	Collection Procedure	Sample Container		Preservation	Sample Preparation	Max HT <sup>o</sup>	Determinative Procedure
			Type	Vial Preparation				
● 200 ug/kg	Coring Device	5035 - Section 6.2.1	Glass Vial w/ PTFE-silicone Septum	5035 - 6.1.1	NaHSO <sub>4</sub> / 4°C	5035 - Section 7.2	14 D	Any recognized VOC Method
				5035 - 6.1.1 <sup>②</sup>	4°C	5035 - Section 7.2	48 H	Any recognized VOC Method
				5035 - 6.1.1 <sup>②</sup>	4°C / -10°C <sup>③, ④</sup>	5035 - Section 7.2	48 H / 14 D <sup>⑤</sup>	Any recognized VOC Method
	EnCore or equivalent	5035 - Section 6.2.1	EnCore or equivalent	5035 - 6.1.1 <sup>②, ⑥, ⑦</sup>	4°C	5035 - Section 7.2	48 H	Any recognized VOC Method
		5035 - Section 6.2.1	EnCore or equivalent	5035 - 6.1.1 <sup>⑥, ⑦</sup>	NaHSO <sub>4</sub> / 4°C	5035 - Section 7.2 <sup>o</sup>	48 H / 14 D <sup>⑤</sup>	Any recognized VOC Method
		5035 - Section 6.2.1	EnCore or equivalent	5035-6.1.1 <sup>② ⑥ ⑦</sup>	4°C / -10°C <sup>③, ④</sup>	5035 - Section 7.2 <sup>o</sup>	48 H / 14 D <sup>⑤</sup>	Any recognized VOC Method
○ 200 ug/kg	EnCore or equivalent	5035 - Section 6.2.2.3 <sup>⑥</sup>	EnCore or equivalent	5035 - 6.1.3 <sup>⑥, ⑦</sup>	4°C	5035 - Sections 7.3.2 & 7.3.3 <sup>o</sup>	48 H / 14 D <sup>o</sup>	Any recognized VOC Method
○ 200 ug/kg <sup>o</sup>	Coring Device	5035 - Section 6.2.2.3 <sup>⑥</sup>	Glass Vial w/ PTFE-silicone Septum	6.1.3 <sup>⑥</sup>	Methanol/PEG + 4°C	5035 - Section 7.3.4	14 D	Any recognized VOC Method
	Conventional Devices	DEP SOP - Section 4.3	Glass w/ PTFE-silicone Septum	6.1.2	4°C	5035 - Sections 7.3.1 - 7.3.3	14 D	Any recognized VOC Method
Oily Waste	Conventional Devices	5035 - Section 6.2.4.2	Glass w/ PTFE-silicone Septum	6.1.4	4°C	5035 - Sections 7.4.1 - 7.4.2	14 D	Any recognized VOC Method
	Conventional Devices	5035 - Section 6.2.4.1	Glass w/ PTFE-silicone Septum	6.1.4	Methanol/PEG + 4°C	5035 - Sections 7.4.3	14 D	Any recognized VOC Method
Dry Wt.	Conventional Devices		Glass with Teflon liner		4°C	5035 - Section 7.5		
Soil Screen	Conventional Devices	DEP SOP - Section 4.3	Glass w/ PTFE-silicone Septum		4°C	5035 - Section 7.1	14 D	Any recognized VOC Method

**Table FS 1000-7**

**Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035**

- 
- ① Maximum time allowable from time/date of collection to sample analysis.
  - ② Eliminate 6.1.1.2; use only organic-free water.
  - ③ Contents of sampling device must be transported to the laboratory at 4°C and stored at -10°C.
  - ④ In order to ensure that vials do not break during freezing, they should be stored on their side or at a slanted angle to maximize surface area.
  - ⑤ Maximum allowable time at 4°C is 48 hours; maximum allowable time to sample analysis is 14 days (from time of sample collection).
  - ⑥ Conducted in the laboratory.
  - ⑦ Entire contents of sampling device are extruded into the sample analysis vial containing the appropriate solvent.
  - ⑧ Procedures are limited only to those situations or programs in which the maximum contamination level does not exceed 200 ug/kg.
  - ⑨ Methanolic preservation in the field is not recommended, but may be used if approved by an FDEP program.

**FS 1000-8**  
**Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II**

Drinking Water					40 CFR Part 136 Table II	
Analyte	Preservation <sup>50</sup>	Holding Time <sup>51</sup>	Holding Time for Extract <sup>52</sup>	Container <sup>53</sup>	Preservation	Holding Time
MICROBIOLOGICAL-BACTERIA	Cool < 10°C, Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>54</sup>			P, G	Cool 4°C, Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>54</sup>	6 hours
Total Coliforms, fecal coliforms & <i>E. coli</i> in drinking water	Cool < 10°C, Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>54</sup>	30 Hours <sup>55</sup>				
Total coliforms and fecal coliforms in source water	Cool < 10°C, Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>54</sup>	8 hours				
Heterotrophic bacteria in drinking water						
RADIONUCLIDES						
Group A <sup>56</sup>	Concentrated HCl, or HNO <sub>3</sub> pH <2 <sup>57,58</sup>	6 months			HNO <sub>3</sub> pH <2	6 months
Iodine-131	None	6 months				
Tritium	None	6 months		G		
Cesium-134	Concentrated HCl to pH <2					
Asbestos	Cool 4°C	48 hours		P, G		
Odor	Cool 4°C	24 hours		G		
502.2	Sodium Thiosulfate or Ascorbic Acid, 4°C, HCl pH<2	14 days		Glass with PFTE Lined Septum		
504.1	Sodium Thiosulfate Cool, 4°C,	14 days	4°C, 24 hours	Glass with PFTE-Lined Septum		
505	Sodium Thiosulfate Cool, 4°C	14 days (7 days for Heptachlor)	4°C, 24 hours	Glass with PFTE-Lined Septum		

**FS 1000-8**  
**Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II**

Analyte	Drinking Water			40 CFR Part 136 Table II		
	Preservation <sup>50</sup>	Holding Time <sup>51</sup>	Holding Time for Extract <sup>52</sup>	Container <sup>53</sup>	Preservation	Holding Time
506	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 14 days	Amber Glass with PTFE-lined Cap		
507	Sodium Thiosulfate Cool, 4°C, Dark	14 days (see method for exceptions)	4°C, dark, 14 days	Amber Glass with PTFE-lined Cap		
508	Sodium Thiosulfate Cool, 4°C, Dark	7 days (see method for exceptions)	4°C, dark, 14 days	Glass with PTFE-lined Cap		
508A	Cool, 4°C	14 days	30 days	Glass with PTFE-lined Cap		
508.1	Sodium Sulfite, HCl pH<2, Cool, 4°C	14 days (see method for exceptions)	30 days	Glass with PTFE-lined Cap		
515.1	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 28 days	Amber Glass with PTFE-lined Cap		
515.2	Sodium Thiosulfate HCl pH<2, Cool, 4°C, Dark	14 days	less than or equal to 4°C, dark, 14 days	Amber Glass with PTFE-lined Cap		
524.2	Ascorbic Acid, HCl pH<2, Cool 4°C	14 days		Glass with PTFE-lined Septum		
525.2	Sodium Sulfite, Dark, Cool, 4°C, HCl pH<2	14 days (see method for exceptions)	30 days from collection	Amber Glass with PTFE-lined Cap		
531.1, 6610	Sodium Thiosulfate Monochloroacetic acid, pH<3, Cool, 4°C	Cool 4°C, 28 days		Glass with PTFE-lined Septum		

**FS 1000-8**  
**Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II**

Drinking Water				40 CFR Part 136 Table II		
Analyte	Preservation <sup>50</sup>	Holding Time <sup>51</sup>	Holding Time for Extract <sup>52</sup>	Container <sup>53</sup>	Preservation	Holding Time
547	Sodium Thiosulfate Cool, 4°C	14 days (18 mo. frozen)		Glass with PTFE-lined Septum		
548.1	Sodium Thiosulfate (HCl pH 1.5-2 if high biological activity), Cool, 4°C, Dark	7 days	14 days less than or equal to 4°C	Amber Glass with PTFE-lined Septum		
549.1	Sodium Thiosulfate (H <sub>2</sub> SO <sub>4</sub> pH<2 if biologically active), Cool, 4°C, Dark	7 days	21 days	High Density Amber Plastic or Silanized Amber Glass		
550, 550.1	Sodium Thiosulfate Cool, 4°C, HCl pH<2	7 days	550, 30 days 550.1, 40 days Dark, 4°C	Amber Glass with PTFE-lined Cap		
551	Sodium Thiosulfate, Sodium Sulfite, Ammonium Chloride or Ascorbic Acid, HCl pH 4.5-5.0, Cool, 4°C	14 days		Glass with PTFE-lined Septum		
555	Sodium Sulfite, HCl, pH less than or equal to 2, Dark, Cool 4°C	14 days		Glass with PTFE-lined cap		
1613B	Sodium Thiosulfate, Cool, 0-4°C, Dark		Recommend 40 days	Amber Glass with PTFE-lined Cap		

<sup>50</sup> Preservation, when required, must be done immediately upon sample collection.

<sup>51</sup> Stated values are the maximum regulatory holding times. Sample processing must begin by the stated time.

<sup>52</sup> Stated time is the maximum time a prepared sample extract may be held before analysis.

<sup>53</sup> (P) polyethylene or (G) or glass. For microbiology, plastic sample containers must be made of sterilizable materials (poly-propylene or other autoclavable plastic).

<sup>54</sup> Addition of sodium thiosulfate is only required if the sample has a detectable amount of residual chlorine, as indicated by a field test using EPA Method 330.4 or 330.2 or equivalent.

**FS 1000-8**  
**Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II**

<sup>55</sup> If samples are analyzed after 30 hours, but within 48 hours of collection, the laboratory is to indicate in the analytical report that the data may be invalid because of excessive delay in sample processing. No samples received after 48 hours are to be accepted or analyzed for compliance with the regulations of the Department of Environmental Protection or the Department of Health.

<sup>56</sup> Group A parameters are: Gross Alpha, Gross Beta, Strontium-89, Strontium-90, Radium-226, Radium-228, Uranium and Photon Emitters.

<sup>57</sup> It is recommended that the preservative be added at the time of collection unless suspended solids activity is to be measured. It is also recommended that samples be filtered, if suspended or settleable solids are present, prior to adding preservative, at the time of collection. However, if the sample has to be shipped to a laboratory or storage area, acidification of the sample (in its original container) may be delayed for a period not to exceed 5 days. A minimum of 16 hours must elapse between acidification and analysis.

<sup>58</sup> If HCl is used to acidify samples, which are to be analyzed for gross alpha or gross beta activities, the acid salts must be converted to nitrate salts before transfer of the samples to planchets.

**Table FS 1000-9**  
**Containers, Preservation and Holding Times for Biosolids Samples and Protozoans**

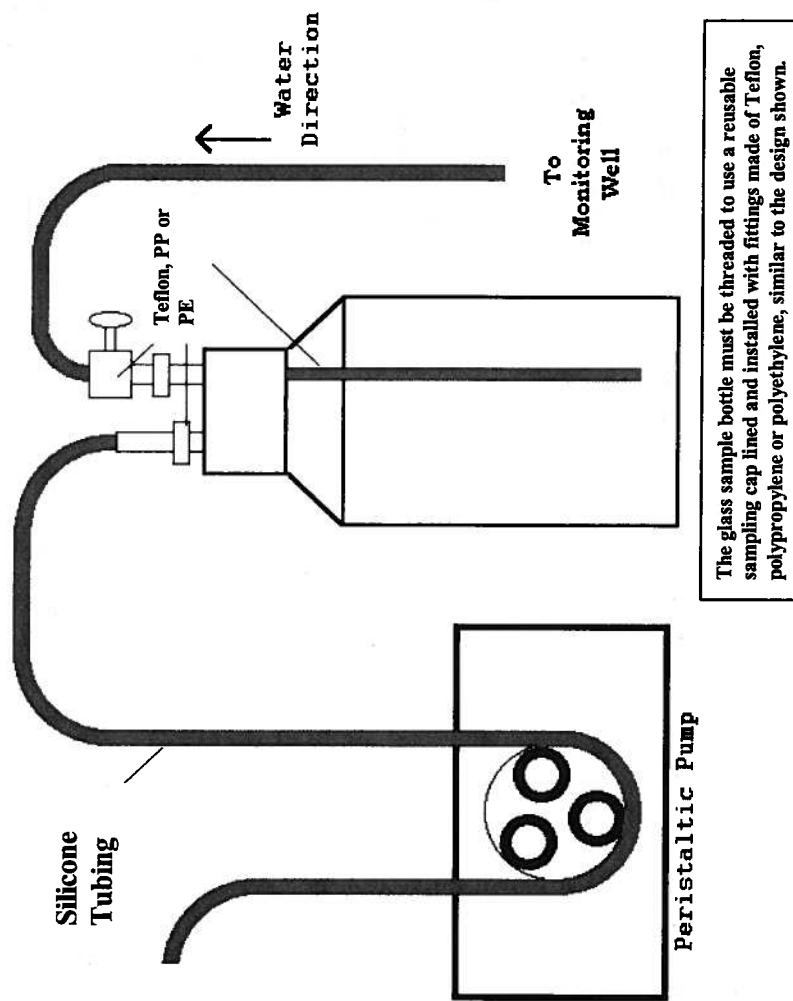
<b>ANALYTE NAME</b>	<b>CONTAINER</b>	<b>PRESERVATION</b>	<b>MAX HOLDING TIME</b>
Fecal Coliform	Plastic or Glass	Cool 4°C	24 hours
Salmonella	Plastic or Glass	< 10°C	24 hours
Enteric Viruses	Plastic or Glass	Up to 25°C	2 hours
Enteric Viruses	Plastic or Glass	2 to 10°C	48 hours
Specific Oxygen Uptake Rate	Plastic or Glass	None	As Soon As Possible
Helminth OVA	Plastic or Glass	< 4°C (Do not Freeze)	24 hours
Cryptosporidium/Giardia	Plastic or Glass	0 - 8°C (Do not Freeze)	96 Hours
Metallics	Plastic or Glass	See Tables FS 1000-4, FS 1000-5 and FS 1000-6	
Other Inorganic Pollutants	Plastic or Glass	See Tables FS 1000-4, FS 1000-5 and FS 1000-6	

**Table FS 1000-10  
Preventive Maintenance Tasks**

<b>INSTRUMENT/ACTIVITY</b>	<b>FREQUENCY</b>
<b>REFRIGERATORS, INCUBATORS, OVENS</b>	
Clean interior	Monthly
Check thermometer temperature against certified thermometer or equivalent	Annually
<b>ANYTICAL BALANCES</b>	
Clean pan and compartment	Daily <sup>1</sup>
Check with Class S weights	Monthly
Manufacturer cleaning and calibration	Annually
<b>pH AND ION SELECTIVE ELECTRODES</b>	
<b>PROBE</b>	
Check probe for cracks and proper levels of filling solution; clean electrode	Daily, Replace as necessary
Check response time	Daily <sup>1</sup>
<b>METER</b>	
Check batteries and electronics for loose connections and cracked leads	Daily <sup>1</sup> , Replace as necessary
<b>TURBIDIMETER</b>	
Clean instrument housing	Monthly
Clean cells	Daily <sup>1</sup>
<b>CONDUCTIVITY METER</b>	
Check batteries and probe cables	Daily <sup>1</sup>
Replatinize Probe	Per manufacturer's recommendations
<b>DISSOLVED OXYGEN METERS</b>	
<b>PROBE</b>	
Check membrane for deterioration; check filling solution	Daily <sup>1</sup> , Replace as necessary
<b>METER</b>	
Battery level and electronics checked	Daily <sup>1</sup> , Replace as necessary
<b>THERMOMETERS</b>	
Check for cracks and gaps in the mercury	Daily <sup>1</sup> , Replace as necessary
<b>TEMPERATURE PROBE</b>	
Check connections, cables	Daily <sup>1</sup>
Check against calibrated thermometer	Daily <sup>1</sup>
<b>AUTOMATIC SAMPLE COLLECTION SYSTEMS (e.g., ISCO, Sigma)</b>	
Check sampler operation (forward, reverse, automatic through three cycles of the purge-pump-purge cycle)	Daily <sup>1</sup> Prior to Sampling Event
Check purge-pump-purge cycle when sampler is installed	Daily <sup>1</sup> Prior to Sampling Event
Check the flow pacer that activates the sampler to assure proper operation	Daily <sup>1</sup> Prior to Sampling Event
Check desiccant	Daily <sup>1</sup> , Replace as Necessary
Check batteries	Daily <sup>1</sup> , Replace as Necessary
Check pumping rate against manufacturer's specifications	Daily <sup>1</sup> , Replace as Necessary

<sup>1</sup>Daily is defined as prior to use or a 12-hour period if equipment is run continuously

**Figure FS 1000-1**  
**Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump**



## **FS 2200. Groundwater Sampling**

### **1. INTRODUCTION AND SCOPE**

1.1. Use these Standard Operating Procedures to collect groundwater samples. They are designed to ensure that the collected samples will be representative of water in the aquifer or target formation and that the samples have not been altered or contaminated by the sampling and handling procedures. These procedures apply to permanently and temporarily installed monitoring wells, wells with installed plumbing, remedial groundwater treatment systems and excavations where groundwater is present. Use of alternative, FDEP-approved and properly documented procedures (e.g., Corporate SOP, ASTM Standards, alternative equipment, etc.) is acceptable if they meet the intent (e.g., sample representativeness and integrity) of this standard (see FA 1000).

1.2. The topics in this SOP include equipment and supply selection, equipment construction materials, and purging and sampling techniques.

1.3. Use the following FDEP SOPs in conjunction with FS 2200:

- FA 1000 Regulatory Scope and Administrative Procedures for Use of DEP SOPs
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FS 2000 General Aqueous Sampling
- FT 1000 Field Testing and Measurement

1.4. Groundwater samples may be collected from a number of different configurations. Each configuration is associated with a unique set of sampling equipment requirements and techniques:

1.4.1. Wells without Plumbing: These wells require that equipment be brought to the well to purge and sample unless dedicated equipment is placed in the well.

1.4.2. Wells with In-Place Plumbing: Wells with in-place plumbing do not require that equipment be brought to the well to purge and sample. In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply. They are generally found at wellfields, industrial facilities, and private residences. See FS 2300 for procedures to sample potable water wells.

1.4.3. Air Strippers or Remedial Systems: These types of systems are installed as remediation devices. Sample these wells like drinking water wells (see FS 2300).

### **FS 2201. Equipment and Supplies**

Use groundwater purging and sampling equipment constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes. In selecting groundwater purging and sampling equipment, give consideration to the depth of the well, the depth to groundwater, the volume of water to be evacuated, the sampling and purging

technique, and the analytes of interest. Refer to Tables FS 1000-1, FS 1000-2, FS 1000-3 and FS 2200-1 for selection of appropriate equipment.

Additional supplies such as reagents, preservatives, and field measurement equipment may be necessary.

1. **FLOW CONTAINER:** FDEP recommends using a flow-through cell or container when collecting measurements for purging stabilization. The design must ensure that fresh formation water continuously contacts the measuring devices and does not aerate the sample or otherwise affect the groundwater properties.

2. **PUMPS:** All pumps or pump tubing must be lowered and retrieved from the well slowly and carefully to minimize disturbance to the formation water. This is especially critical at the air/water interface. Avoid the resuspension of sediment particles (turbidity) at the bottom of the well or adhered to the well casing during positioning of the pump or tubing.

#### 2.1. Above-Ground Pumps

2.1.1. Variable Speed Peristaltic Pump: Use a variable speed peristaltic pump to purge groundwater from wells when the static water level in the well is no greater than 20-25 feet below land surface (BLS). If the water levels are deeper than 18-20 feet BLS, the pumping velocity will decrease.

2.1.1.1. A variable speed peristaltic pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.1.1.2. Most analyte groups can be sampled with a peristaltic pump if the tubing and pump configurations are appropriate. See Table FS 1000-3 for proper tubing selection and pump configurations.

2.1.2. Variable Speed Centrifugal Pump: A variable speed centrifugal pump can be used to purge groundwater from 2-inch and larger internal diameter wells. **Do not use** this type of pump to collect groundwater samples.

2.1.2.1. When purging is complete, do not allow the water that remains in the tubing to fall back into the well. Install a check valve at the end of the purge tubing, and withdraw the tubing slowly from the well while the pump is still running.

2.1.2.2. See Table FS 1000-3 for proper tubing selection and allowable analyte groups.

#### 2.2. Submersible Pumps

2.2.1. Variable Speed Electric Submersible Pump: A variable speed submersible pump can be used to purge and sample groundwater from 2-inch and larger internal diameter wells.

2.2.1.1. A variable speed submersible pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.1.2. Make sure that the pump housing, fittings, check valves and associated hardware are constructed of stainless steel. Make sure that any other materials are compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.1.3. Install a check valve at the output side of the pump to prevent backflow.

2.2.1.4. If purging **and** sampling for organics:

- The entire length of the delivery tube must be Teflon, Polyethylene or Polypropylene (PP) tubing.
- The electrical cord must be sealed in Teflon, Polyethylene or PP and any cabling must be sealed in Teflon, Polyethylene or PP, or be constructed of stainless steel.
- All interior components that contact the sample water (impeller, seals, gaskets, etc.) must be constructed of stainless steel or Teflon.

2.2.2. Variable Speed Bladder Pump: A variable speed positive displacement bladder pump (no-gas contact) can be used to purge and sample groundwater from 3/4-inch and larger internal diameter wells.

2.2.2.1. A variable speed bladder pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.2.2. The bladder pump system is composed of the pump, the compressed air tubing, the water discharge tubing, the controller and a compressor or compressed gas supply.

2.2.2.3. The pump consists of a bladder and an exterior casing or pump body that surrounds the bladder and two (2) check valves. These parts can be composed of various materials, usually combinations of polyvinyl chloride (PVC), Teflon, Polyethylene, PP and stainless steel. Other materials must be compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.2.4. If purging and sampling for organics:

- The pump body must be constructed of stainless steel and the valves and bladder must be Teflon, Polyethylene or PP.
- The entire length of the delivery tube must be Teflon, Polyethylene or PP.
- Any cabling must be sealed in Teflon, Polyethylene or PP, or be constructed of stainless steel.

2.2.2.5. Permanently installed pumps may have a PVC pump body as long as the pump remains in contact with the water in the well.

3. BAILERS:

3.1. Purging: FDEP does not recommend using bailers for purging unless no other equipment can be used or purging with a bailer has been specifically authorized by an FDEP program, permit, contract or order (see Table FS 2200-3). Use a bailer if there is non-aqueous phase liquid (free product) in the well or non-aqueous phase liquid is suspected to be in the well. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate FDEP program or project manager. If a bailer is used, follow FS 2213, section 4, with no deviations.

3.2. Sampling: Bailers may be used to routinely collect some analyte groups or under specific circumstances for other analyte groups (see Table FS 2200-3).

3.3. Construction and Type:

3.3.1. Bailers must be constructed of materials compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

3.3.1.1. Stainless steel, Teflon, Polyethylene and PP bailers may be used to sample all analytes.

3.3.2. Use disposable bailers when sampling grossly contaminated sample sources.

3.3.3. FDEP recommends using dual check valve bailers when collecting samples.

3.3.4. Use bailers with a controlled flow bottom when collecting volatile organic samples.

3.3.5. Use bailers that can be pressurized when collecting filtered samples for metals.

3.4. Contamination Prevention:

3.4.1. Keep the bailer wrapped (foil, butcher paper, etc.) until just before use.

3.4.2. Use protective gloves to handle the bailer once it is removed from its wrapping.

3.4.3. Handle the bailer by the lanyard to minimize contact with the bailer surface.

4. LANYARDS

4.1. Lanyards must be made of non-reactive, non-leachable material. They may be cotton twine, nylon, stainless steel, or may be coated with Teflon, Polyethylene or PP.

4.2. Discard cotton twine, nylon, and non-stainless steel braided lanyards after sampling each monitoring well.

4.3. Decontaminate stainless steel, coated Teflon, Polyethylene and PP lanyards between monitoring wells (see FC 1003). They do not need to be decontaminated between purging and sampling operations.

**FS 2210. GROUNDWATER PURGING**

**FS 2211. Water Level and Purge Volume Determination**

Collect representative groundwater samples from the aquifer. The amount of water that must be purged from a well is determined by the volume of water and/or field parameter stabilization.

1. GENERAL EQUIPMENT CONSIDERATIONS

1.1. Selection of appropriate purging equipment depends on the analytes of interest, the well diameter, transmissivity of the aquifer, the depth to groundwater and other site conditions.

1.2. Use a pump to purge the well unless no other equipment can be used or there is non-aqueous phase liquid in the well or non-aqueous phase liquid is suspected to be in the well.

1.3. Bailers may be used if approved by an FDEP program, or if bailer use is specified in a permit, contract or FDEP order (see Table FS 2200-3). If used, bailers must be of appropriate type and construction, and the user must follow the procedure outlined in FS 2213, section 4, with no deviations. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate FDEP program or project manager. FDEP does not recommend using bailers because improper bailing:

- 1.3.1. Introduces atmospheric oxygen which may precipitate metals (i.e., iron) or cause other changes in the chemistry of the water in the sample (i.e., pH)
- 1.3.2. Agitates groundwater which may bias volatile and semi-volatile organic analyses due to volatilization
- 1.3.3. Agitates the water in the aquifer and resuspends fine particulate matter
- 1.3.4. Surges the well loosening particulate matter in the annular space around the well screen
- 1.3.5. May introduce dirt into the water column if the sides of the casing wall are scraped

## 2. INITIAL INSPECTION

- 2.1. Verify the identification of the monitoring well by examining markings, sign plates, placards or other designations.
- 2.2. Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well cap.
- 2.3. Inspect the exterior protective casing of the monitoring well for damage and document the results of the inspection if there is a problem.
- 2.4. It is recommended that you place a protective covering around the well head. Replace the covering if it becomes soiled or ripped.
- 2.5. Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary.

## 3. WATER LEVEL MEASUREMENTS: Use an electronic probe or chalked tape to determine the water level.

- 3.1. Decontaminate all equipment before use.
- 3.2. Measure the depth to groundwater from the top of well casing to the nearest 0.01 foot and always measure from the same reference point or survey mark on the well casing. If there is no reference mark, measure from the north side of the casing.
- 3.3. Record the measurement and the reference point.

### 3.4. Electronic Probe

- 3.4.1. Follow the manufacturer's instructions for use.
- 3.4.2. Record the measurement.

### 3.5. Chalked Line Method: This method is not recommended if collecting samples for organic or inorganic parameters.

- 3.5.1. Lower chalked tape into the well until the lower end is in the water (usually determined by the sound of the weight hitting the water).
- 3.5.2. Record the length of the tape relative to the reference point (see section 3.2 above).
- 3.5.3. Quickly remove the tape from the well.
- 3.5.4. Record the length of the wetted portion to the nearest 0.01 foot.
- 3.5.5. Determine the depth to water by subtracting the length of the wetted portion (see section 3.5.3 above) from the total length (see section 3.5.2 above). Record the result.

#### 4. WATER COLUMN DETERMINATION

Do not determine the total depth of the well by lowering the probe to the bottom of the well before purging and sampling. If the well must be sounded, delay purging and sampling activities for at least 24 hours after the well was sounded or for a time sufficient to meet the purge stabilization criterion for turbidity. Alternatively, collect samples before sounding the well.

4.1. Subtract the depth to the top of the water column from the total well depth to determine the length of the water column.

4.2. The total well depth depends on the well construction. Some wells may be drilled in areas of sinkhole or karst formations or rock leaving an open borehole. Attempt to find the total borehole depth in cases where there is an open borehole below the cased portion.

#### 5. WELL WATER VOLUME

5.1. Calculate the total volume of water in gallons in the well using the following equation:

$$V = (0.041)d \times d \times h$$

Where: V = volume in gallons  
d = well diameter in inches  
h = height of the water column in feet

5.2. The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (Gallons per Foot of Water) for the appropriate diameter well:

$$V = [\text{Gallons per Foot of Water}] \times h$$

Where: V = volume in gallons  
h = height of the water column in feet

Casing Internal Diameter	Approximate Gallons per Foot of Water
0.75"	0.02
1"	0.04
1.25"	0.06
2"	0.16
3"	0.37
4"	0.65
5"	1.02
6"	1.47
12"	5.88

5.3. Record all measurements and calculations in the field records.

#### 6. PURGING EQUIPMENT VOLUME

6.1. Calculate the total volume of the pump, associated tubing and container that is used for in situ measurements (flow container), if used, using the following equation:

$$V = p + ((0.041)d \times d \times l) + fc$$

Where: V = volume in gallons  
p = volume of pump in gallons  
d = tubing diameter in inches  
l = length of tubing in feet  
fc = volume of flow cell in gallons

7. When collecting samples from multiple wells on a site, if the groundwater elevation data are to be used to construct groundwater elevation contour maps, all water level measurements must be taken within the same 24-hour time interval unless a shorter time period is required by a FDEP program. If the site is tidally influenced, complete the water level measurements within the time frame of an incoming or outgoing tide.

## **FS 2212. Well Purging Techniques**

The selection of the purging technique and equipment is dependent on the hydrogeologic properties of the aquifer, especially depth to groundwater and hydraulic conductivity. The intent of proper purging is to stabilize the water level in the well and minimize the hydraulic stress to the hydrogeologic formation.

Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging completion criteria.

A flowchart which summarizes purging procedure options is in Figure FS 2200-2.

Equipment selection must comply with construction and configuration requirements specified in Table FS 2200-1 and the discussions in FS 2201.

1. MEASURING THE PURGE VOLUME: The volume of water that is removed during purging must be recorded. Therefore, you must measure the volume during the purging operation.

1.1. Collect the water in a graduated container and multiply the number of times the container was emptied by the volume of the container, or

1.2. Estimate the volume based on pumping rate. This technique may be used only if the pumping rate is constant. Determine the pumping rate by measuring the amount of water that is pumped for a fixed period of time or use a flow meter.

1.2.1. Calculate the amount of water that is discharged per minute:

$$D = \frac{\text{Measured amount}}{\text{Total time in minutes}}$$

1.2.2. Calculate the time needed to purge one (1) well volume or one (1) purging equipment volume:

$$\text{Time} = \frac{V}{D}$$

Where: V = well volume determined from FS 2211, section 5, or purging equipment volume

D = discharge rate calculated in section 1.2.1. above

1.2.3. Make new measurements (see section 1.2.1 above) each time the pumping rate is changed, or

1.3. Use a totalizing flow meter.

- 1.3.1. Record the reading on the totalizer prior to purging.
- 1.3.2. Record the reading on the totalizer at the end of purging.
- 1.3.3. Subtract the reading on the totalizer prior to purging from the reading on the totalizer at the end of purging to obtain the volume purged.

- 1.4. Record in the field records the times that purging begins and ends.

## 2. STABILIZATION MEASUREMENT FREQUENCY

Begin to record stabilization measurements after pumping the minimum volume as prescribed below. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

If the well screened interval is not known, use option 2.1 below.

2.1. Wells with Fully Submerged Screen and Pump or Intake Tubing Placed at the Top of the Water Column (conventional purge): Purge a minimum of one (1) well volume prior to collecting measurements of the field parameters. Allow at least one quarter (1/4) well volume to purge between subsequent measurements.

2.2. Wells with Fully Submerged Screen and Pump or Intake Tubing Placed Within the Screened Interval (minimizing purge volume): Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) volume of the pump, associated tubing and flow container (if used) prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two (2) to three (3) minutes apart. Purge at least three (3) volumes of the pump, associated tubing and flow container, if used, prior to collecting a sample.

2.3. Wells with a Partially Submerged Well Screen: Purge a minimum of one (1) well volume prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two (2) to three (3) minutes apart.

3. PURGING COMPLETION: DEP recommends the use of a flow-through container to measure the stabilization parameters discussed below. Alternatively, measure all parameters *in situ* by inserting measurement probes into the well at the depth appropriate for the purging option. Purging is considered complete if the criteria in section 3.1, 3.2 or 3.3 below are satisfied. Make every attempt to satisfy the criteria in section 3.1. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

3.1. Three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits. The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements of temperature, pH and specific conductance cannot exceed the stated limits. The last three consecutive measurements of dissolved oxygen and turbidity must all be at or below the listed thresholds.

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- Temperature:  $\pm 0.2^{\circ} \text{C}$
- pH:  $\pm 0.2$  Standard Units
- Specific Conductance:  $\pm 5.0\%$  of reading
- Dissolved Oxygen:  $\leq 20\%$  Saturation
- Turbidity:  $\leq 20$  NTU

Document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.2. If the criteria in section 3.1 above for dissolved oxygen and/or turbidity cannot be met, then three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits. The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits.

- Temperature:  $\pm 0.2^{\circ} \text{C}$
- pH:  $\pm 0.2$  Standard Units
- Specific Conductance:  $\pm 5.0\%$  of reading
- Dissolved Oxygen:  $\pm 0.2$  mg/L or 10%, whichever is greater
- Turbidity:  $\pm 5$  NTUs or 10%, whichever is greater

Additionally, document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of conditions at the site that may cause the Dissolved Oxygen to be high and/or Dissolved Oxygen measurements made within the screened or open hole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that may cause the Turbidity to be high and any procedures that will be used to minimize Turbidity in the future.

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- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

If from review of the submitted data the Department determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring conditions, then only the first four (4) items are required to be submitted in future reports. However, if the Department cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that may have caused the affected parameter(s) to be high is required to be submitted in future reports.

3.3. If the stabilization parameters in either section 3.1 or 3.2 cannot be met, and all attempts have been made to minimize the drawdown, check the instrument condition and calibration, purging flow rate and all tubing connections to determine if they might be affecting the ability to achieve stable measurements. All measurements that were made during the attempt must be documented. The sampling team leader may decide whether or not to collect a sample or to continue purging after five (5) well volumes (conventional purge section 2.1 or 2.3 above) or five (5) volumes of the screened interval (minimizing purge volumes in section 2.2 above).

Further, the report in which the data are submitted must include the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- Drawdown in the well, if any.
- A description of conditions at the site that may cause the Dissolved Oxygen to be high and/or Dissolved Oxygen measurements made within the screened or open hole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that may cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

If from review of the submitted data the FDEP determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring conditions, then only the first four (4) items are required to be submitted in future reports. However, if the FDEP cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that may have caused the affected parameter(s) to be high is required to be submitted in future reports.

3.4. One fully dry purge (not recommended). This criterion applies only if purging was attempted per FS 2212, FS 2213, and section 3.4.1 below, and if it is impossible to balance the pumping rate with the rate of recharge at very low pumping rates (< 100 mL/minute).

3.4.1. If wells have previously and consistently purged dry, when purged according to FS 2212 and FS 2213, and the current depth to groundwater indicates that the well will purge dry during the current sampling event, minimize the amount of water removed from the well by using the same pump to purge and collect the sample:

3.4.1.1 Place the pump or tubing intake within the well screened interval.

3.4.1.2 Use very small diameter Teflon, Polyethylene or PP tubing and the smallest possible pump chamber volume to minimize the total volume of water pumped from the well and to reduce drawdown.

3.4.1.3 Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.

3.4.1.4 Pump at the lowest possible rate (100 mL/minute or less) to reduce drawdown to a minimum.

3.4.1.5 Purge at least two (2) volumes of the pumping system (pump, tubing and flow cell, if used).

3.4.1.6 Measure pH, Specific Conductance, Temperature, Dissolved Oxygen and Turbidity and begin to collect the samples (see FS 2222).

4. Collect samples immediately after purging is complete. The time period between completing the purge and sampling cannot exceed six (6) hours. If sample collection does not occur within one (1) hour of purging completion, re-measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity just prior to collecting the sample. If the measured values are not within 10 percent of the previous measurements, re-purge the well. The exception is "dry" wells (see section 3.4 above).

#### 5. LANYARDS

1.2. Securely fasten lanyards, if used, to any downhole equipment (bailers, pumps, etc.).

1.3. See FS 2201, section 4, for acceptable lanyard types and use.

1.4. Use bailer lanyards in such a way that they do not touch the ground surface.

### FS 2213. Purging Wells Without Plumbing (Monitoring Wells)

#### 1. TUBING/PUMP PLACEMENT

1.1. Do not lower the pump or tubing to the bottom of the well. Pump or tubing placement will be determined by the purging option selected in FS 2212, section 2 above. Minimizing Purge Volume: If the following conditions can be met, position the intake hose or pump at the midpoint of the screened or open hole interval.

- The same pump must be used for both purging and sampling,
- The well screen interval must be less than or equal to 10 feet, and
- The well screen must be fully submerged.

1.2. Conventional Purging: Position the pump or intake tubing in the top one foot of the water column or no deeper than necessary for the type of pump. If purging with a bailer, see section 4 below.

1.3. Partially Submerged Screened Interval: If the well screen or borehole is partially submerged, and the pump will be used for both purging and sampling, position the pump midway between the measured water level and the bottom of the screen. Otherwise position the pump as described in section 1.2 above. If purging with a bailer, see section 4 below.

2. NON-DEDICATED (PORTABLE) PUMPS

2.1. Variable Speed Peristaltic Pump

- 2.1.1. Attach a short section of tubing to the discharge side of the pump and into a graduated container.
- 2.1.2. Attach one end of a length of new or precleaned tubing to the pump head flexible hose.
- 2.1.3. Place the tubing per one of the options in FS 2213, section 1 above.
- 2.1.4. Measure the depth to groundwater at frequent intervals.
- 2.1.5. Record these measurements.
- 2.1.6. Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
- 2.1.7. If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
- 2.1.8. If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.
- 2.1.9. Record the purging rate each time the rate changes.
- 2.1.10. Measure the purge volume by one of the methods outlined in FS 2212, section 1.
- 2.1.11. Record this measurement.
- 2.1.12. Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.2. Variable Speed Centrifugal Pump

- 2.2.1. Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
- 2.2.2. Place the decontaminated suction hose so that water is always pumped from the top of the water column.
- 2.2.3. Equip the suction hose with a foot valve to prevent purge water from re-entering the well.
- 2.2.4. Measure the depth to groundwater at frequent intervals.
- 2.2.5. Record these measurements.
- 2.2.6. Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
- 2.2.7. If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.2.8. If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.2.9. Record the purging rate each time the rate changes.

2.2.10. Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.2.11. Record this measurement.

2.2.12. Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.3. Variable Speed Electric Submersible Pump

2.3.1. Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.3.2. Carefully position the decontaminated pump per one of the options in FS 2213, section 1 above.

2.3.3. Measure the depth to groundwater at frequent intervals.

2.3.4. Record these measurements.

2.3.5. Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.3.6. If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.3.7. If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.3.8. Record the purging rate each time the rate changes.

2.3.9. Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.3.10. Record this measurement.

2.3.11. Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.4. Variable Speed Bladder Pump

2.4.1. Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.4.2. Attach the tubing and carefully position the pump per one of the options in FS 2213, section 1 above.

2.4.3. Measure the depth to groundwater at frequent intervals.

2.4.4. Record these measurements.

2.4.5. Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.4.6. If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.4.7. If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.4.8. Record the purging rate each time the rate changes.

2.4.9. Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.4.10. Record this measurement.

2.4.11. Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

3. DEDICATED PORTABLE PUMPS: Place dedicated pumps per one of the options in FS 2213, section 1 above.

3.1. Variable Speed Electric Submersible Pump

3.1.1. Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

3.1.2. Measure the depth to groundwater at frequent intervals.

3.1.3. Record these measurements.

3.1.4. Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

3.1.5. If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdraw with the recharge rate.

3.1.6. Record the purging rate each time the rate changes.

3.1.7. Measure the purge volume by one of the methods outlined in FS 2212, section 1.

3.1.8. Record this measurement.

3.2. Variable Speed Bladder Pump

3.2.1. Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

3.2.2. Measure the depth to groundwater at frequent intervals.

3.2.3. Record these measurements.

3.2.4. Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

3.2.5. If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdraw with the recharge rate.

3.2.6. Record the purging rate each time the rate changes.

3.2.7. Measure the purge volume by one of the methods outlined in FS 2212, section 1.

3.2.8. Record this measurement.

4. BAILERS: FDEP recommends against using bailers for purging except as a last contingency, or if free product is present in the well or suspected to be in the well. However, they may be used if approved by an FDEP program, or specified in a permit, contract or FDEP order (see Table FS 2200-3 and FS 2211, section 1.3). If in doubt about the appropriateness of using a

bailer at a site or during a particular sampling event, contact the appropriate FDEP program or project manager.

- 4.1. Minimize handling the bailer as much as possible.
  - 4.1.1. Remove the bailer from its protective wrapping just before use.
  - 4.1.2. Attach a lanyard of appropriate material (see FS 2201, section 4).
  - 4.1.3. Use the lanyard to move and position the bailer.
- 4.2. Lower and retrieve the bailer slowly and smoothly.
  - 4.2.1. Lower the bailer carefully into the well to a depth approximately a foot above the water column.
    - 4.2.1.1. When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached (see section 4.2.2 below).
  - 4.2.2. Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column. Ensure that the length of the bailer does not exceed the length of the water column.
  - 4.2.3. Allow time for the bailer to fill with aquifer water as it descends into the water column.
    - 4.2.3.1. Carefully raise the bailer. Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.
- 4.3. Measure the purge volume by one of the methods outlined in FS 2212, section 1.
  - 4.3.1. Record the volume of the bailer.
- 4.4. Continue to carefully lower and retrieve the bailer as described above until the purging completion conditions specified in FS 2212, section 3, have been satisfied.
  - 4.4.1. Remove at least one (1) well volume before collecting measurements of the field parameters. Take each subsequent set of measurements after removing at least one quarter (1/4) well volume between measurements.

**FS 2214. Purging Wells With Plumbing (production wells or permanently installed pumps equipped with sampling ports or sampling spigots)**

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, etc.

**1. CONTINUOUSLY RUNNING PUMPS**

- 1.1. Select the spigot that is closest to the pump and before any storage tanks (if possible).
- 1.2. Remove all hoses, aerators and filters (if possible).
- 1.3. Open the spigot and purge at maximum flow.
- 1.4. If a storage tank is located between the pump and the spigot, purge the volume of the tank, lines and spigot.
- 1.5. If the spigot is before any storage tank, purge until sufficient volume is removed to flush the stagnant water from the spigot and the tap line to the spigot.

1.6. Reduce the flow rate to  $\leq 500$  mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to  $\leq 100$  mL/minute before collecting the samples.

2. INTERMITTENTLY RUNNING PUMPS

2.1. Open the spigot and purge sufficient volume to flush the spigot and lines and until the purging completion criteria in FS 2212, section 3, have been met.

2.2. Reduce the flow rate to  $\leq 500$  mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to  $\leq 100$  mL/minute before collecting the samples.

**FS 2215. Purging Airstrippers and Remedial Treatment Systems**

If collecting samples for groundwater contamination monitoring, follow FS 2214 above.

**FS 2220. GROUNDWATER SAMPLING TECHNIQUES**

1. Purge wells using the techniques outlined in FS 2210.

2. Replace the protective covering around the well if it is soiled or torn after completing the purging operations.

3. EQUIPMENT CONSIDERATIONS

3.1. Some pumps may be used for sampling groundwater. Follow all notes and restrictions as defined in Table FS 2200-1 and discussed in Equipment and Supplies (FS 2201) when using pumps and other equipment to collect samples.

**NOTE: The only pumps that are currently approved for use in collecting volatile organic samples through the pump are stainless steel and Teflon variable speed submersible pumps, stainless steel and Teflon or Polyethylene variable speed bladder pumps, and permanently installed PVC bodied pumps as long as the pump remains in contact with the water in the well at all times.**

3.2. Collect the sample into the sample container from the sampling device. **Do not** use intermediate containers.

3.3. In order to avoid contaminating the sample or loss of analytes from the sample:

3.3.1. Handle the sampling equipment as little as possible.

3.3.2. Minimize the equipment that is exposed to the sample.

3.3.3. Minimize aeration of samples collected for VOC analysis.

3.3.2.1. Reduce flow rates to  $\leq 100$  mL/minute when collecting VOC samples.

3.4. Dedicated Sampling Equipment

3.4.1. Whenever possible, use dedicated equipment because it significantly reduces the chance of cross-contamination.

3.4.2. Dedicated is defined as equipment that is to be used solely for one location for the life of that equipment (e.g., permanently mounted pump).

3.4.3. All material construction and restrictions from Table FS 2200-1 also apply to dedicated equipment. Purchase equipment with the most sensitive analyte of interest in mind.

#### 3.4.4. Cleaning/Decontamination

- 3.4.4.1 Clean or make sure dedicated pumps are clean before installation. They do not need to be cleaned prior to each use but must be cleaned if they are withdrawn for repair or servicing.
- 3.4.4.2 Clean or make sure any permanently mounted tubing is clean before installation.
- 3.4.4.3 Change or clean tubing when the pump is withdrawn for servicing.
- 3.4.4.4 Clean any replaceable or temporary parts as specified in FC 1000.
- 3.4.4.5 Collect equipment blanks on dedicated pumping systems when the tubing is cleaned or replaced.
- 3.4.4.6 Clean or make sure dedicated bailers are clean before placing them into the well.
- 3.4.4.7 Collect an equipment blank on dedicated bailers before introducing them into the water column.
- 3.4.4.8 Suspend dedicated bailers above the water column if they are stored in the well.

### **FS 2221. Sampling Wells Without Plumbing**

1. SAMPLING WITH PUMPS: Variable speed stainless steel and Teflon submersible pumps and stainless steel, Teflon or Polyethylene bladder pumps, and permanently installed PVC-bodied pumps, as long as the pump remains in contact with the water in the well at all times, may be used to sample for all organics. The delivery tubing must be Teflon, Polyethylene or PP.

**Extractable organics** may be collected through a peristaltic pump if flexible tubing made of approved materials is used in the pump head or a vacuum trap is used (see Figure FS 2200-1 for specific configuration). Follow all notes and restrictions as defined in Table FS 2200-1 and discussed in Equipment and Supplies (FS 2201) when using pumps to collect samples.

Do not lower the pump or tubing to the bottom of the well.

#### 1.1. Peristaltic Pump

1.1.1. Volatile Organics: Collect volatile organics last. If the pump tubing is placed within the screened interval, the tubing cannot be reinserted into the well, and steps 1.1.1.7, 1.1.1.13 and 1.1.1.17 below are prohibited.

- 1.1.1.1. Ensure that there is sufficient tubing volume to fill the requisite number of VOC vials.
- 1.1.1.2. Remove the drop tubing from the inlet side of the pump.
- 1.1.1.3. Submerge the drop tubing into the water column.
- 1.1.1.4. Prevent the water in the tubing from flowing back into the well.
- 1.1.1.5. Remove the drop tubing from the well.
- 1.1.1.6. Carefully allow the groundwater to gravity drain into the sample vials. Avoid turbulence. Do not aerate the sample. The flow rate must be  $\leq 100$  mL/minute.
- 1.1.1.7. Repeat steps 1.1.1.2 through 1.1.1.5 until enough vials are filled.

- 1.1.1.8. Alternatively, use the pump to fill the drop tubing.
- 1.1.1.9. Quickly remove the tubing from the pump.
- 1.1.1.10. Prevent the water in the tubing from flowing back into the well.
- 1.1.1.11. Remove the drop tubing from the well.
- 1.1.1.12. Carefully allow the groundwater to drain into the sample vials. Avoid turbulence. Do not aerate the sample. The flow rate must be  $\leq 100$  mL/minute.
- 1.1.1.13. Repeat steps 1.1.1.8 through 1.1.1.12 until enough vials are filled.
- 1.1.1.14. Or, use the pump to fill the drop tubing
- 1.1.1.15. Withdraw the tubing from the well.
- 1.1.1.16. Reverse the flow on the peristaltic pump to deliver the sample into the vials at a slow, steady rate. The flow rate must be  $\leq 100$  mL/minute.
- 1.1.1.17. Repeat steps 1.1.1.14 through 1.1.1.16 until enough vials are filled.

1.1.2. Extractable Organics

- 1.1.2.1. Assemble the components of the pump and trap according to Figure FS 2200-1.
- 1.1.2.2. The sample container should be the trap bottle.
- 1.1.2.3. All equipment that contacts the groundwater **before** the sample container must be constructed of Teflon, Polyethylene, PP, stainless steel or glass, including the transport tubing to and from the sample container, the interior liner of the container cap and all fittings. **Do not use a rubber stopper as a cap.**
- 1.1.2.4. Connect the outflow tubing from the container to the influent side of the peristaltic pump.
- 1.1.2.5. Turn the pump on and reduce the flow rate to a smooth and even flow.
- 1.1.2.6. Discard a small portion of the sample to allow an air space.
- 1.1.2.7. Preserve (if required), label and complete the field notes.

1.1.3. Inorganics

- 1.1.3.1. Inorganic samples may be collected from the effluent tubing.
- 1.1.3.2. If samples are collected from the pump, decontaminate all tubing (including the tubing in the head) or change it between wells.
- 1.1.3.3. Preserve (if required), label and complete field notes.

1.2. Variable Speed Bladder Pump

- 1.2.1. If sampling for organics the pump body must be constructed of stainless steel and the valves and bladder must be Teflon. All tubing must be Teflon, Polyethylene, or PP and any cabling must be sealed in Teflon, Polyethylene or PP, or made of stainless steel.
- 1.2.2. After purging to a smooth even flow, reduce the flow rate.
- 1.2.3. When sampling for volatile organic compounds, reduce the flow rate to 100 mL/minute or less, if possible.

### 1.3. Variable Speed Submersible Pump

1.3.1. The housing must be stainless steel.

1.3.2. If sampling for organics, the internal impellers, seals and gaskets must be constructed of stainless steel, Teflon, Polyethylene or PP. The delivery tubing must be Teflon, Polyethylene or PP and the electrical cord must be sealed in Teflon and any cabling must be sealed in Teflon or constructed of stainless steel.

1.3.3. After purging to a smooth even flow, reduce the flow rate.

1.3.4. When sampling for volatile organic compounds, reduce the flow rate to 100 mL/minute or less, if possible.

2. **SAMPLING WITH BAILERS:** A high degree of skill and coordination are necessary to collect representative samples with a bailer. When properly used, bailers may be used to collect samples for certain analyte groups and under specific conditions (see Table FS 2200-3). They must be of an appropriate type and construction (see FS 2201, section 3), and must be used as outlined below. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate FDEP program or project manager.

### 2.1. General Considerations

2.1.1. Minimize handling the bailer as much as possible.

2.1.1.1. Wear sampling gloves.

2.1.1.2. Remove the bailer from its protective wrapping just before use.

2.1.1.3. Attach a lanyard of appropriate material (see FS 2201, section 4).

2.1.1.4. Use the lanyard to move and position the bailers.

2.1.2. Do not allow the bailer or lanyard to touch the ground.

### 2.1.3. Rinsing

2.1.3.1. If the bailer is certified precleaned, no rinsing is necessary.

2.1.3.2. If both a pump and a bailer are to be used to collect samples, rinse the exterior and interior of the bailer with sample water from the pump before removing the pump.

2.1.3.3. If the purge pump is not appropriate for collecting samples (e.g., non-inert components), rinse the bailer with by collecting a single bailer of the groundwater to be sampled. Use the technique described in section 2.2, Bailing Technique, below.

2.1.3.4. Discard the water appropriately.

2.1.3.5. **Do not** rinse the bailer if Oil & Grease, TRPHs, etc., (see FS 2006) are to be collected.

### 2.2. Bailing Technique

2.2.1. Collect all samples that are required to be collected with a pump before collecting samples with the bailer.

2.2.2. Raise and lower the bailer gently to minimize stirring up particulate matter in the well and the water column which can increase sample turbidity.

2.2.3. Lower the bailer carefully into the well to a depth approximately a foot above the water column. Ensure that the length of the bailer does not exceed the length of the water column.

2.2.3.1. When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached (see section 2.2.3 above).

2.2.4. Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column.

2.2.5. Allow time for the bailer to fill with aquifer water as it descends into the water column.

2.2.6. Do not allow the bailer to touch the bottom of the well or particulate matter will be incorporated into the sample.

2.2.6.1. Carefully raise the bailer (see section 2.2.2 above). Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.

2.2.7. Lower the bailer to approximately the same depth each time.

2.2.8. Collect the sample.

2.2.8.1. Install a device to control the flow from the bottom of the bailer and discard the first few inches of water. Reduce the flow to  $\leq 100$  mL/minute when collecting VOC samples.

2.2.8.2. Fill the appropriate sample containers by allowing the sample to slowly flow down the side of the container. Minimize aeration of VOC samples.

2.2.8.3. Discard the last few inches of water in the bailer.

2.2.9. Repeat steps 2.2.1 through 2.2.8.3 for additional samples.

2.2.10. As a final step measure the DO, pH, temperature, turbidity and specific conductance after the final sample has been collected.

2.2.10.1. Record all measurements and note the time that sampling was completed.

3. **SAMPLING WELLS WITH FLOATING NON-AQUEOUS PHASE LIQUID:** FDEP does not recommend the sampling of wells with floating non-aqueous phase liquid for trace contaminants. This concerns primarily petroleum related sites, but includes any chemical product (e.g., solvent) that floats on the water table. Sampling is acceptable if the information is to be used for the purpose of remedial design.

Sample data from such wells cannot provide useful information regarding the level of contamination. Furthermore, FDEP believes that these wells may never provide legitimate data as they may have become (permanently) chemically damaged by the product being in contact with the well casing for an extended period of time.

FDEP does reserve the right to require sampling of these wells, not for levels of trace contaminants, but for confirmation of an appropriate remediation technique. This type of sampling is performed **below** the non-aqueous phase layer (see section 3.2 below).

3.1. Non-Aqueous Phase Liquid Sampling: Non-aqueous phase liquid may be evident in a cased monitoring well or in an open excavation.

3.1.1. Non-aqueous phase liquid is normally sampled for two reasons:

- Documentation for its existence and thickness; and
- Determination of the type of product so that the proper analyses can be performed to determine extent. This is only feasible for relatively recent releases as it may not be possible to identify weathered product.

3.1.2. Disposable plastic (acrylic, clear PVC) bailers are recommended for sampling. Disposable Polyethylene and PP bailers are also acceptable. Other wide mouth vessels may be used for sampling non-aqueous phase liquid in an excavation.

3.1.3. Monitoring Well

3.1.3.1. If a non-aqueous phase liquid is identified in a monitoring well during the water level measurement, measure its thickness in the well. If the thickness of the non-aqueous phase liquid is greater than 0.01 foot or product globules are present, collect a sample using a precleaned disposable bailer.

3.1.3.2. Measure the product thickness to the nearest 0.01 foot after withdrawing the bailer.

3.1.3.3. Pour a portion of the product into a glass sample container.

3.1.3.4. This sample is considered a concentrated waste. Therefore, package the container in protective wrapping to prevent breakage, isolate from other samples, and ice to 4°C.

3.1.4. Excavation

3.1.4.1. If non-aqueous phase liquid is observed in an open excavation, a glass sample container or a precleaned intermediate vessel may be used to collect the sample.

3.1.4.2. Securely tie a lanyard to the container and lower it into the excavation.

3.1.4.3. Gently lower and retrieve the container so that no solid material is released or collected.

3.1.4.4. If sufficient water is available, a bailer can be used.

3.1.4.5. Although not recommended, screened casing can be placed (or augered and placed) in the bottom of the excavation and the product sampled with a bailer.

3.1.4.6. Avoid dangerous situations, such as standing too close to the edge of an excavation, riding in the backhoe bucket, or entering a trench or excavation that may collapse.

3.1.4.7. Follow all applicable OSHA regulations.

3.1.5. Equipment that is dedicated to sampling non-aqueous phase liquid does not need to be cleaned according to the standard, full decontamination protocols. Acrylic or PVC bailers that are never used for trace contaminant sampling may be cleaned as listed below. It is recommended that all cleaning be done in the lab, office or base of operations and not in the field.

3.1.5.1. Disassemble bailers and intermediate vessels and soak in hot, sudsy tap water using a brush to clean away all particulates and greasy films.

3.1.5.2. Rinse with hot tap water.

3.1.5.3. Thoroughly rinse with analyte free water.

3.1.5.4. An optional acid rinse may be used to strip the equipment of any hard to clean residues.

3.1.5.5. The solvent rinse is not mandatory since this equipment is not used for contaminant sampling, other than the product itself. It is not recommended on clear acrylic.

**3.2. Sampling Below Product**

3.2.1. This type of depth-specific sampling to attempt to sample the dissolved constituents in the water column below the product layer is performed only at the request of FDEP or its designee.

3.2.2. These data provide information that helps define adequate groundwater treatment. Without these data, incorrect (and sometimes unnecessarily expensive) remediation techniques may be designed for a situation where they are not required.

3.2.3. There are some substantial logistical problems involved with sending a sampler through non-aqueous phase liquid to sample the groundwater below. Although there are some products designed specifically for this type of sampling, they are expensive and the results may not be commensurate with their cost. The use of "self-engineered" equipment or coverings may be the best option.

3.2.4. These data are only to be used for qualitative use and will aid in deciding on an appropriate remediation technique.

3.2.5. Wrapping bailers and tubing in plastic seems to be the most popular technique in getting past the product layer.

3.2.6. Although not recommended, some have wrapped submersible pumps in several layers of plastic and retrieved each layer by a separate lanyard. One suggestion would be to use a rigid piece of stainless steel tubing wrapped in plastic.

3.2.6.1. Once the covered tubing is past the layer, pull up on the plastic, piercing the plastic and exposing the (somewhat) clean tubing inlet.

3.2.6.2. Introduce the wrapped hose slowly to not entrain any more product into the dissolved layer located below.

3.2.6.3. Also, perform this procedure with a peristaltic pump or a vacuum pump linked to a trap bottle. To use this setup, the water table must be no deeper than 15-20 feet, realizing that actual sampling may be occurring several feet below the product layer.

**FS 2222. Sampling Low Permeability Aquifers or Wells that have Purged Dry**

1. Collect the sample(s) after the well has been purged according to FS 2212, section 3.4. Minimize the amount of water removed from the well by using the same pump to purge and collect the sample. If the well has purged dry, collect samples as soon as sufficient sample water is available.

2. Measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity at the time of sample collection.

3. Advise the analytical laboratory and the client that the usual amount of sample for analysis may not be available.

### **FS 2223. Sampling Wells With In-Place Plumbing**

1. If a storage tank is present, locate a cold water spigot, valve or other sampling point close to the well head between the pump and the storage tank. If there is no sampling location between the pump and the storage tank, locate the spigot, valve or other sampling point closest to the tank.
2. Remove all screens or aerators and reduce the flow rate to no more than 500 mL/minute. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less. Collect the samples directly into the appropriate containers.

### **FS 2224. Sampling Airstripper and Remedial Treatment System Sampling**

Reduce the flow rate to less than 500 mL/minute and begin sample collection. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less. Collect the samples directly into the appropriate containers.

### **FS 2225. Filtering Groundwater Samples**

1. FILTERING GROUNDWATER FOR METALS: Filtered groundwater samples can only be collected after approval from the FDEP program or project manager. If filtering is approved, the FDEP program or permit may require both filtered and unfiltered samples to be collected and reported. Unless specified by the program, use a 1 micrometer ( $\mu\text{m}$ ) filter.

1.1. Use a disposable, high capacity, 1  $\mu\text{m}$  in-line filter.

1.1.1. Flush the filter with 30-50 mL of analyte free water or an inert gas (nitrogen) to remove atmospheric oxygen;

or

1.1.2. Insert the filter on the high pressure side (i.e., on the delivery side) of the pump. Hold the filter upright with the inlet and outlet vertical. Pump water from the aquifer through the filter until all atmospheric oxygen has been removed.

1.2. Use a variable speed pump that can be fitted with an in-line filter on the outlet end. Peristaltic pumps, bladder pumps or submersible pumps can be used when water levels are no greater than 20 to 25 feet deep; bladder pumps or submersible pumps must be used when water levels are greater than 20 to 25 feet deep.

1.2.1. Install new or precleaned silastic tubing in the variable speed peristaltic pump head at each monitoring well.

1.2.2. Use new or precleaned delivery tubing at each monitoring well.

1.3. Collect filtered samples by either of the methods outlined below if the static water level in the well is too deep for a variable speed peristaltic pump and a variable speed electric submersible pump or variable speed bladder pump of appropriate configuration is not available. Do not agitate the sample or expose it to atmospheric oxygen. **Do not** pour the sample into any intermediate vessel for subsequent filtration.

1.3.1. Collect the sample in a Polyethylene, Teflon or PP bailer that can be pressurized. When the bailer has been retrieved, immediately connect the filter and begin to pressurize the bailer;

or

1.3.2. Collect the sample with a bailer and immediately place the intake tube of the peristaltic pump into the full bailer and begin pumping the water through the filter as described in section 1.2 above.

1.4. **Do not** use the following equipment for filtering groundwater samples for metals:

1.4.1. Any pump and apparatus combination in which the filter is on the vacuum (suction) side of the pump.

1.4.2. Any type of syringe or barrel filtration apparatus.

1.4.3. Any filter that is not encased in a one-piece, molded unit.

## **FS 2220. REFERENCES**

1. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Standard Methods for the Examination of Water and Wastewater, Page 4-101, 18th Edition, 1992.
2. Florida Department of Environmental Protection, DEP Standard Operating Procedures for Laboratory Operations and Sample Collection Activities, DEP QA-001/92, September 1992.
3. U.S. Environmental Protection Agency, Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.

**Appendix FS 2200**  
**Tables, Figures and Forms**

Table FS 2200-1	Equipment for Collecting Groundwater Samples
Table FS 2200-2	Dissolved Oxygen Saturation
Table FS 2200-3	Allowable Uses for Bailers
Figure FS 2200-1	Pump and Trap for Extractable Organics
Figure FS 2200-2	Groundwater Purging Procedure
Form FD 9000-24	Groundwater Sampling Log

**Table FS 2200-1**  
**Equipment for Collecting Groundwater Samples**

Activity	Equipment Type
Well Purging	Variable speed centrifugal pump Variable speed submersible pump Variable speed bladder pump Variable speed peristaltic pump Bailer with lanyard: <b>Not Recommended</b>
Well Stabilization	pH meter DO meter Conductivity meter Thermometer/Thermistor Turbidimeter Flow-through cell Multi-function meters
Sample Collection	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Bailer with lanyard (See Table FS 2200-3)
Filtration	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Pressurized bailer 1.0 µm high capacity molded filter
Groundwater Level	Electronic sensor Chalked tape

**Table FS 2200-2**  
**Dissolved Oxygen Saturation**

TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L
deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%
15.0	10.084	2.017	19.0	9.276	1.855	23.0	8.578	1.716	27.0	7.968	1.594
15.1	10.062	2.012	19.1	9.258	1.852	23.1	8.562	1.712	27.1	7.954	1.591
15.2	10.040	2.008	19.2	9.239	1.848	23.2	8.546	1.709	27.2	7.940	1.588
15.3	10.019	2.004	19.3	9.220	1.844	23.3	8.530	1.706	27.3	7.926	1.585
15.4	9.997	1.999	19.4	9.202	1.840	23.4	8.514	1.703	27.4	7.912	1.582
15.5	9.976	1.995	19.5	9.184	1.837	23.5	8.498	1.700	27.5	7.898	1.580
15.6	9.955	1.991	19.6	9.165	1.833	23.6	8.482	1.696	27.6	7.884	1.577
15.7	9.934	1.987	19.7	9.147	1.829	23.7	8.466	1.693	27.7	7.870	1.574
15.8	9.912	1.982	19.8	9.129	1.826	23.8	8.450	1.690	27.8	7.856	1.571
15.9	9.891	1.978	19.9	9.111	1.822	23.9	8.434	1.687	27.9	7.842	1.568
16.0	9.870	1.974	20.0	9.092	1.818	24.0	8.418	1.684	28.0	7.828	1.566
16.1	9.849	1.970	20.1	9.074	1.815	24.1	8.403	1.681	28.1	7.814	1.563
16.2	9.829	1.966	20.2	9.056	1.811	24.2	8.387	1.677	28.2	7.800	1.560
16.3	9.808	1.962	20.3	9.039	1.808	24.3	8.371	1.674	28.3	7.786	1.557
16.4	9.787	1.957	20.4	9.021	1.804	24.4	8.356	1.671	28.4	7.773	1.555
16.5	9.767	1.953	20.5	9.003	1.801	24.5	8.340	1.668	28.5	7.759	1.552
16.6	9.746	1.949	20.6	8.985	1.797	24.6	8.325	1.665	28.6	7.745	1.549
16.7	9.726	1.945	20.7	8.968	1.794	24.7	8.309	1.662	28.7	7.732	1.546
16.8	9.705	1.941	20.8	8.950	1.790	24.8	8.294	1.659	28.8	7.718	1.544
16.9	9.685	1.937	20.9	8.932	1.786	24.9	8.279	1.656	28.9	7.705	1.541
17.0	9.665	1.933	21.0	8.915	1.783	25.0	8.263	1.653	29.0	7.691	1.538
17.1	9.645	1.929	21.1	8.898	1.780	25.1	8.248	1.650	29.1	7.678	1.536
17.2	9.625	1.925	21.2	8.880	1.776	25.2	8.233	1.647	29.2	7.664	1.533
17.3	9.605	1.921	21.3	8.863	1.773	25.3	8.218	1.644	29.3	7.651	1.530
17.4	9.585	1.917	21.4	8.846	1.769	25.4	8.203	1.641	29.4	7.638	1.528
17.5	9.565	1.913	21.5	8.829	1.766	25.5	8.188	1.638	29.5	7.625	1.525
17.6	9.545	1.909	21.6	8.812	1.762	25.6	8.173	1.635	29.6	7.611	1.522
17.7	9.526	1.905	21.7	8.794	1.759	25.7	8.158	1.632	29.7	7.598	1.520
17.8	9.506	1.901	21.8	8.777	1.755	25.8	8.143	1.629	29.8	7.585	1.517
17.9	9.486	1.897	21.9	8.761	1.752	25.9	8.128	1.626	29.9	7.572	1.514
18.0	9.467	1.893	22.0	8.744	1.749	26.0	8.114	1.623	30.0	7.559	1.512
18.1	9.448	1.890	22.1	8.727	1.745	26.1	8.099	1.620	30.1	7.546	1.509
18.2	9.428	1.886	22.2	8.710	1.742	26.2	8.084	1.617	30.2	7.533	1.507
18.3	9.409	1.882	22.3	8.693	1.739	26.3	8.070	1.614	30.3	7.520	1.504
18.4	9.390	1.878	22.4	8.677	1.735	26.4	8.055	1.611	30.4	7.507	1.501
18.5	9.371	1.874	22.5	8.660	1.732	26.5	8.040	1.608	30.5	7.494	1.499
18.6	9.352	1.870	22.6	8.644	1.729	26.6	8.026	1.605	30.6	7.481	1.496
18.7	9.333	1.867	22.7	8.627	1.725	26.7	8.012	1.602	30.7	7.468	1.494
18.8	9.314	1.863	22.8	8.611	1.722	26.8	7.997	1.599	30.8	7.456	1.491
18.9	9.295	1.859	22.9	8.595	1.719	26.9	7.983	1.597	30.9	7.443	1.489

Derived using the formula in Standard Methods for the Examination of Water and Wastewater, Page 4-101, 18th Edition, 1992

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FS 2200 Groundwater Sampling

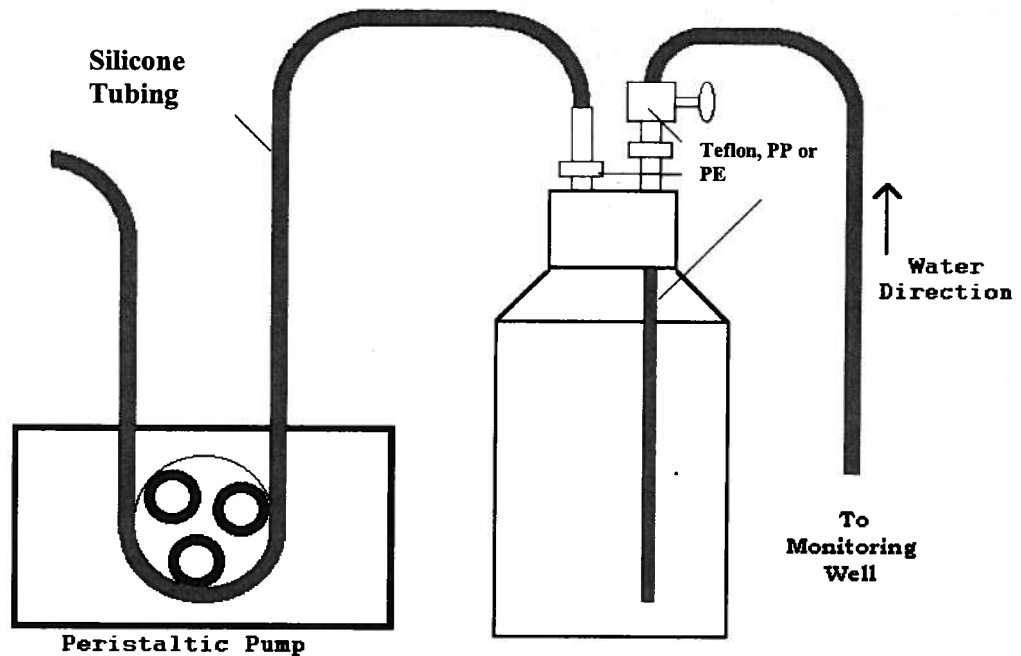
**Table FS 2200-3**  
**Allowable Uses for Bailers**

ANALYTE GROUP(S)	PURGING (Not Recommended)	SAMPLING	
	Use:	Use:	Not Recommended:
Volatile Organics Extractable Organics Radionuclides, including Radon Metals Volatile Sulfides	If allowed by permit, program, contract or order  or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If concentrations exceed action levels, the purpose is to monitor effective treatment, and the FDEP program allows the use of bailers;  or If specified by FDEP permit, program, contract or order.  or If operated by a skilled individual with documented training in proper techniques and using appropriate equipment. Field documentation must demonstrate that the procedure in FS 2221, section 2 was followed without deviation.	If concentrations are near or below the stated action levels;  or If a critical decision (e.g., clean closure) will be made based on the data;  or If data are to demonstrate compliance with a permit or order.
Petroleum Hydrocarbons (TRPH) & Oil & Grease	If allowed by permit, program, contract or order  or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	Only if allowed by permit, program, contract or order as samples should be collected into the container without intermediate devices.	Unless allowed by permit, program, contract or order.

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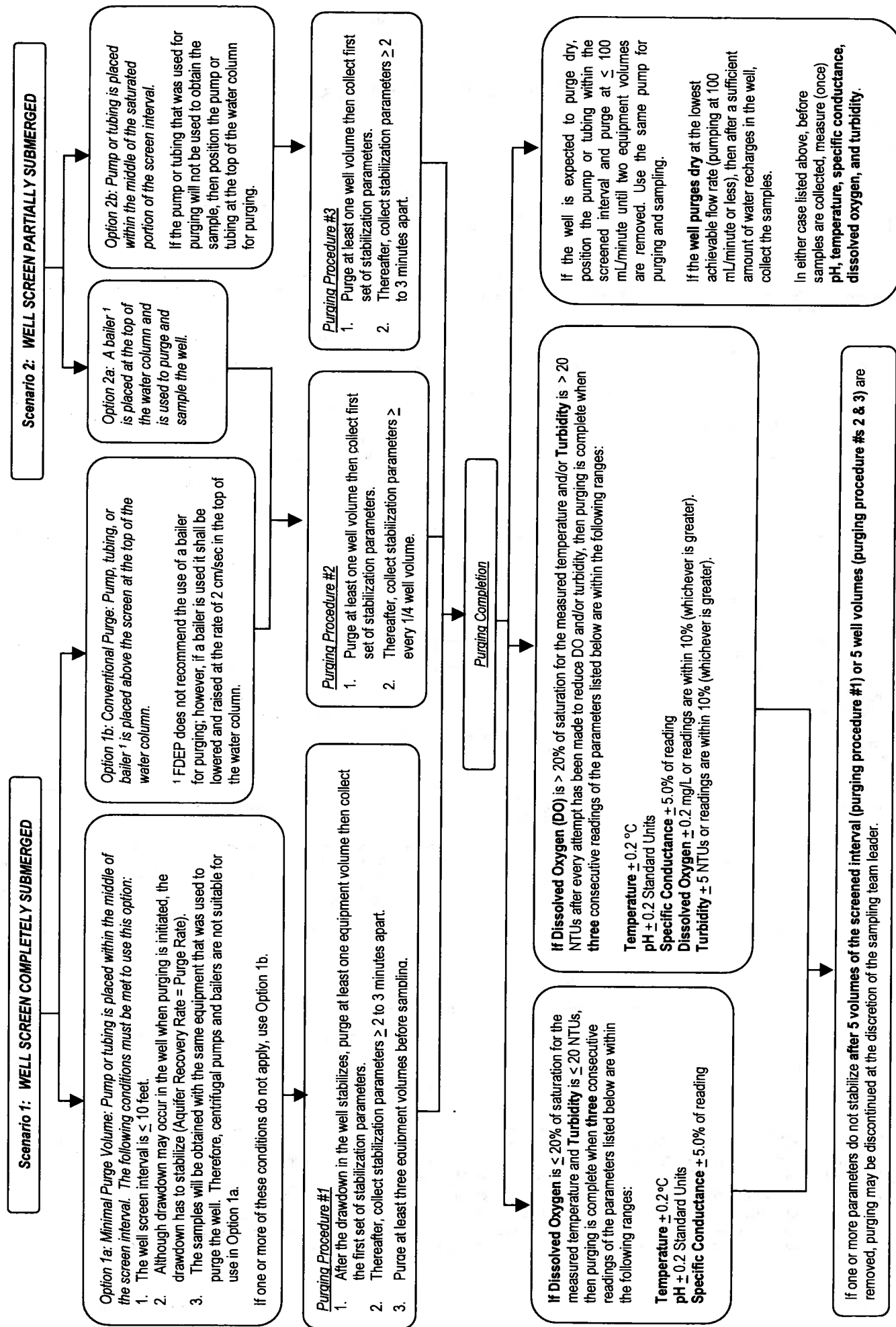
ANALYTE GROUP(S)	PURGING (Not Recommended)	SAMPLING	
	Use:	Use:	Not Recommended:
Biologicals Inorganic Non-Metallics Aggregate Organics Microbiological Physical and Aggregate Properties	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If all analytes collected from the well can be collected with a bailer; or If collected <u>after</u> collecting all analytes that require the use of a pump.	Before collecting any analytes that must be collected with a pump.
Ultra-Trace Metals	Never	Never	

**Figure 2200-1**  
**Pump and Trap for Extractable Organics**



The glass sample bottle must be threaded to use a reusable sampling cap lined and installed with fittings made of Teflon, polypropylene or polyethylene, similar to the design shown.

Figure FS 2200-2 Groundwater Purging Procedure



# GROUNDWATER SAMPLING LOG

SITE NAME:		SITE LOCATION:	
WELL NO:	SAMPLE ID:		DATE:

## PURGING DATA

[illegible]

## SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:				SAMPLER(S) SIGNATURES:			SAMPLING INITIATED AT:		SAMPLING ENDED AT:	
PUMP OR TUBING DEPTH IN WELL (feet):				SAMPLE PUMP FLOW RATE (mL per minute):			TUBING MATERIAL CODE:			
FIELD DECONTAMINATION:    Y       N				FIELD-FILTERED:    Y       N      FILTER SIZE: _____ µm Filtration Equipment Type: _____			DUPLICATE:                  Y                  N			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH				
REMARKS:										
MATERIAL CODES:     AG = Amber Glass;    CG = Clear Glass;    PE = Polyethylene;    PP = Polypropylene;    S = Silicone;    T = Teflon;    O = Other (Specify)										
SAMPLING/PURGING EQUIPMENT CODES:    APP = After Peristaltic Pump;    B = Bailor;    BP = Bladder Pump;    ESP = Electric Submersible Pump;    PP = Peristaltic Pump RFPF = Reverse Flow Peristaltic Pump;    SM = Straw Method (Tubing Gravity Drain);    VT = Vacuum Trap;    O = Other (Specify)										

**NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

**pH:**  $\pm 0.2$  units **Temperature:**  $\pm 0.2$  °C **Specific Conductance:**  $\pm 5\%$  **Dissolved Oxygen:** all readings  $\leq 20\%$  saturation (see Table FS 2200-2); optionally,  $\pm 0.2$  mg/L or  $\pm 10\%$  (whichever is greater) **Turbidity:** all readings  $\leq 20$  NTU; optionally  $+ 5$  NTU or  $\pm 10\%$  (whichever is greater)

**APPENDIX C**

**REGULATORY COMMENTS**